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ABSTRACT

This learning packet contains teaching suggestions and student learning materials for a course in basic horticulture aimed at preparing students for employment in a number of horticulture areas. The packet includes nine sections and twenty instructional units. Following the standard format established for Oklahoma vocational education materials in 1970, the units include eight basic components: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. All of the unit components zero in on measurable and observable learning outcomes, and encourage hands-on experience. Topics covered in the eight sections are plant growth and reproduction; plant propagation; soils; fertilizers; plant growth media; plant problems and control; pruning; plant identification; and potting procedures. (KC)

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Basic Horticulture

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FOREWORD

Today horticulture teachers are faced with increasing problems of what to teach and whom to serve. The many different fields in horticulture demand well-educated students who possess the information and skills needed for employment. During the task analysis of this manual, competencies needed for more than one horticulture occupation were identified and included in this manual. Future development will be in specialized areas of horticulture.

The purpose of this manual is to provide a basic core of instruction in horticulture. Although the format reflects a systematic approach to instructional materials development, the information in *Basic Horticulture* should be adapted and modified to coincide with local conditions. It is intended that the materials be coupled with the instructor's own methods and experience to make the training process complete.

Dr. Francis T. Tuttle, Director
Oklahoma State Department of Vocational
and Technical Education

Bob Patton, Coordinator
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and Technical Education

PREFACE

The purpose of *Basic Horticulture* is to enable students to function effectively in the horticulture industry. By increasing the opportunities available through practical, "hands-on" experience, we also help industry by providing trained personnel.

It is the responsibility of the instructor to supplement, adapt, and personalize *Basic Horticulture* to create an interest and excitement in each student. By encouraging and guiding the student, each instructor can help develop well-qualified personnel ready to assume their positions in the horticulture field of their choice. It is the sincere wish of this writer that each instructor and student might experience a growing interest in all areas of horticulture through the use of this material.

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I would like to thank Dr. Richard Payne for encouraging me in my career choice of horticulture. Special thanks go to my husband, Bill Geer, who has given much needed support and encouragement during the writing of this manual.

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USE OF THIS PUBLICATION

Instructional Units

Basic Horticulture includes nine sections and twenty instructional units. A standard format was established in 1970 for the development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components which form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. Depending on the specific objectives, transparency masters, assignment sheets, and job sheets may or may not be included in the unit of instruction.

All of the unit components "zero in" toward measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching-learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine:

A. Amount of material that can be covered in each class period
B. Skills which must be demonstrated
    1. Supplies and equipment needed
    2. Amount of practice needed
    3. Amount of class time needed for demonstrations
C. Supplementary materials, such as pamphlets and filmstrips, that must be ordered
D. Resource people who must be contacted

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction, and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important that the teachers and students have a common understanding of the intent of the objectives. Following is a list of performance terms, their meanings, and behavioral synonyms which may have been used in this material.

A. Name--The individual supplies a name for objects, events, or people

Behavioral synonyms: Label, list, letter, record, reiterate, repeat, write

B. Identify–The individual selects a named, described, or pictured object by pointing to it, touching it, picking it up, or selecting it

Behavioral synonyms: Select, mark, match, choose, judge

C. State a rule--The individual communicates a relationship or principle which could be used to solve problems or perform a task

D. Apply a rule--The individual supplies an answer to a problem by using a stated relationship or principle

Behavioral synonyms: Solve, calculate

E. Describe--The individual relates sufficient characteristics or properties of an object or event so that a second individual will be able to state what is being discussed

Behavioral synonyms: Define, discuss, interpret, recite, tell how, tell what happens when

F. Distinguish--The individual selects an object or event from two or more which are easily confused

Behavioral synonyms: Discriminate, differentiate

G. Order--The individual arranges three or more objects or events in a sequence based on a stated property

Behavioral synonyms: Arrange, sequence, list in order, classify, divide, isolate, sort

H. Construct--The individual makes a physical object, a verbal statement, or a drawing

(NOTE: Construct is used when the finished product or result is important.)

Behavioral synonyms: Draw, make, build, design, formulate, reproduce, transcribe, convert, put together, compile

I. Demonstrate--The individual performs several operations necessary to carry out a specified process

(NOTE: Demonstrate is used when it is desirable to watch the student perform a task, one of the highest levels of performance.)

Behavioral synonyms: Show your work, show procedure, perform an experiment, perform the steps, operate, remove, replace, turn off/on, (dis) assemble, (dis) connect

The objectives should be provided for students and stressed throughout the teaching-learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may be also used as a quick pretest to determine prior knowledge of students and if further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

This component is included only in teacher material. The suggested activities page assists teachers during the preparation stage of the teaching-learning process by providing suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed are ones used in the development of each unit. They should be used by the teacher to supplement knowledge of the subject area or to help students with particular interest or occupational objective in the area covered.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, and provide motivation for each unit.

Transparency Masters (white pages in teacher material and green in student material)

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. It is recommended that teachers stand away from the overhead projector when discussing transparency material to avoid speaking too loudly.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience with the information. They assist students in the application of knowledges which are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or teacher for checking student progress.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

Instruments in job sheets are not in order of use. This should be taught in the classroom. In this way, students will not depend entirely on job sheets for instrument setup.

A teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet accordingly to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

An additional part of the job sheet was added due to the need for a consistent format to assist teachers in evaluating job skills. This part of the job sheet is a checklist that can be used in several ways. After the teacher has covered the procedure and has demonstrated the skill, the student may then take the job sheet into the clinical laboratory practice area. Students may evaluate each other's performance by marking the Performed Well or Needs Improvement boxes in pencil. When the student feels that he or she is ready to perform the procedure for the instructor, the boxes may be checked in ink by the teacher and comments may be added.

The faculty should agree upon the critical steps of the skill and the value of each step if a grade is to be given. The checklist may have to be adapted to local policies and procedures. Steps that do not apply to your particular area may be omitted or marked N/A (non-applicable).

Tests (yellow pages)

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper-pencil and performance objectives must be evaluated.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, eighty-five percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each individual question. The final unit grade should be obtained by using the "paper-pencil" score along with teacher evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

These component are designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center is assigned a specific abbreviation. For example, *Basic Horticulture* has been abbreviated HORT. The units are then numbered consecutively within each section. An example of a page number is HORT 1-A. Since CIMC publications are loose leaf, this system of page numbering was adopted so pages from different manuals would not get mixed up.

Methods of Disseminating Material

Materials may be given out a unit or page at a time to keep the material before the students always new. Some teachers ask students to furnish a three-ring binder for the units while studying a particular unit. This is more convenient for taking the materials home to study. Each unit is then placed in the larger binders upon its completion. The large binders may be purchased at cost from the CIMC. Some teachers have stored the materials by units in filing cabinets or boxes until needed for use. All the units may be given out at once if desired.

Student materials should be provided for each student for best results. They may be purchased in-state for less than a teacher can reproduce the materials, especially when the teacher's time is considered. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. The tests are collated all together at the back of student material and should be removed and stored until needed. The students should be allowed to take their materials home at the end of the year.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

PLANT GROWTH AND RESPONSES
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to evaluate plant growth and responses, and recognize environmental problems and nutritional deficiencies. This knowledge will be evidenced by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with plant processes to the correct definitions.
2. Label the primary parts of a plant.
3. Match plant processes to their descriptions.
4. Label the two types of vascular systems.
5. Label the three types of root systems.
6. Label the parts of a complete flower.
7. Arrange in order steps in photosynthesis.
8. Write the formula for respiration.
9. Name cultural and environmental factors which affect plant growth.
10. Complete a chart of symptoms associated with environmental problems.
11. Distinguish between macronutrients and micronutrients needed for plant growth.
12. Match symptoms of nutritional deficiencies to their causes.
13. Recommend solutions to environmental problems.
14. Recognize nutritional problems from their symptoms.

PLANT GROWTH AND RESPONSES
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and assignment sheets.

   E. Select several types of plants and allow students to observe vascular systems.

   F. Bring in different plants and flowers or photos for students to identify while completing Assignment Sheets #1 and #3.

   G. Visit a local nursery or plant grower and ask for plants that exhibit nutritional or other growth problems.

   H. Place one plant in the light needed for photosynthesis and an identical plant in the dark. Have students monitor changes in appearance after several days.

   I. Subject plants to environmental and cultural stress. Allow the student to observe and identify the problems.

   J. Give the student a complete flower and allow him or her to identify the parts.

   K. Have students place plants under bell jars to demonstrate respiration.

   L. Give test.

   M. Retest if needed.

II. Instructional materials

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Parts of Plant

      2. TM 2--Vascular Systems

      3. TM 3--Root Systems

4. TM 4--Parts of a Flower
5. TM 5--Photosynthesis

D. Assignment sheets

1. Assignment Sheet #1--Label Primary Parts of a Plant
2. Assignment Sheet #2--Label Vascular Systems of Monocots and Dicots
3. Assignment Sheet #3--Label Primary Parts of a Complete Flower
4. Assignment Sheet #4--Recommend Solutions to Environmental Problems
5. Assignment Sheet #5--Recognize Nutritional Problems from their Symptoms

E. Answers to assignment sheets

F. Test

G. Answers to test

III. Unit references

A. Laurie, A; Kiplinger, D. C.; and Nelson, K. S. *Commercial Flower Forcing.* 7th ed. New York: McGraw-Hill Book Co., 1968.

B. Denison, Ervin L. *Principles of Horticulture.* New York: The Macmillan Co., 1967.

C. Richardson, William B., and Moore, Gary E. *Working in Horticulture.* New York: Gregg Division, McGraw-Hill Book Co., 1980.

PLANT GROWTH AND RESPONSES
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Node--Joint where both leaves and buds appear on stem

B. Internode--Portion of a stem between nodes

C. Petiole--The stem of a leaf

D. Terminal bud--Any bud found growing at the tip of a stem

E. Lateral bud--Bud appearing on the side of a stem, usually at a node

(NOTE: This may also be called the axillary bud.)

F. Vascular system--Xylem and phloem combined; transport water and nutrients within the plant

G. Monocot--Plant with one cotyledon in its seed

H. Dicot--Plant with two cotyledons in its seed

I. Xylem--Part of plant that transfers water up from roots to leaves

J. Phloem--Part of plant which transports food from leaves to other parts of plant

K. Cambium--Narrow layer of cells in vascular system of dicots that eventually becomes bark and lays down wood tissue

L. Fibrous root system--Greatly branched root system without a dominant root

M. Taproot system--Vertical, deep penetrating central root with few laterals

N. Complete flower--Flower containing all reproductive parts

O. Incomplete flower--Flower containing either pistil or stamens

P. Photosynthesis--Manufacture of carbohydrates in green plants from carbon dioxide and water

Q. Chlorophyll--Green coloring matter found in plants

(NOTE: Chlorophyll is needed for photosynthesis.)

INFORMATION SHEET

- R. Macronutrient--Nutrient needed by plant in large quantities
- S. Micronutrient--Nutrient needed by plant in small quantities
- T. Cotyledon--Embryonic seed leaf, easily seen in large seeds
- U. Transpiration--Loss of water vapor from leaf surface
- V. Pith--Corky center of the stem of dicots
- W. Respiration--Opposite of photosynthesis; energy is used by plant, resulting in water and carbon dioxide

II. Primary parts of a plant (Transparency 1, Assignment Sheet #1)

- A. Root
- B. Stem
    - 1. Node
    - 2. Internode
- C. Leaf
- D. Buds
    - 1. Terminal bud
    - 2. Lateral bud
- E. Petiole
- F. Abscission layer

III. Plant processes

(NOTE: These plant portions may be used for reproduction.)

A. Root--Serves as an anchor; supports upper plant; absorbs water and nutrients; stores food

Example: Sweet potatoes, beets and carrots are specialized storage roots

B. Stem--Supports plant and leaves; transports food and water to other portions of plant; stores food

C. Leaf--Manufactures food for plant; stores food; controls transpiration of plant

(NOTE: Transpiration is evaporation from the inner leaf.)

INFORMATION SHEET

D. Bud--Stores food; serves as a growth site

E. Flower--Site of seed formation

IV. Vascular systems (Transparency 2, Assignment Sheet #2)

A. Monocot--Vascular bundle

1. Xylem
2. Phloem

B. Dicot

1. Xylem
2. Phloem
3. Cambium
4. Pith

V. Root systems (Transparency 3)

A. Fibrous

Examples: Grasses and grains

B. Taproot

Examples: Pecan tree, cotton

C. Adventitious

Examples: Poison ivy, English ivy, philodendron

VI. Parts of a complete flower (Transparency 4, Assignment Sheet #2)

A. Stamen

1. Filament
2. Anther

B. Pistil

1. Stigma
2. Style

INFORMATION SHEET

3. Ovary
    a. Pollen tube
    b. Embryo sac
    c. Ovule

C. Corolla

(NOTE: All the petals make up the corolla.)

D. Calyx

(NOTE: All the sepals make up the calyx.)

VII. Steps in photosynthesis (Transparency 5)

A. Carbon dioxide (CO_2) is absorbed by leaves

B. Water (H_2O) is absorbed by roots

C. $6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$

(NOTE: $C_6H_{12}O_6$ is a sugar.)

D. Sugars are converted to starches and stored

E. Starches can be converted back to sugar to be used in protein, fats, or as energy

VIII. Respiration

A. Starches are converted to sugars as the plant needs them

B. Sugars are converted to energy

C. Photosynthesis process is reversed

D. $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{energy}$

IX. Cultural and environmental factors which affect plant growth

A. Light

B. Temperature

C. Water

(NOTE: Improper watering is the most common cause of plant death. Allow soil to dry somewhat between waterings.)

INFORMATION SHEET

D. Humidity

E. Nutrition

(NOTE: Requirements depend on the individual plant.)

INFORMATION SHEET

X. Symptoms associated with environmental problems

(NOTE: For outdoor plants, proper plant selection can eliminate environmental problems.)

FACTOR	SYMPTOMS	CAUSE	SOLUTION
Light	Plant is "stretching." Stem is elongated between leaves. Color is pale green. Outdoor plants may thin out from too much shade.	Too low light	Move gradually to area with more light (NOTE: Do not move immediately to a high light area or sunburn may result.)
	Leaves are very close together. Brown patches are appearing on leaves and color is bleached. Tips of leaves may be browning.	Too much light	Move gradually to area with lower light
Temperature	Leaves are soft, mushy and quickly turn brown or black. May occur only on leaf tips.	Cold damage	Maintain proper temperatures. Remove damaged parts. (NOTE: Winds can drop temperature and cause damage.)
	Plant wilts quickly. On flowering, plants, flowers are bleached. Some plants may show browning on leaf edge.	Temperatures too high	Lower temperatures to recommended range.
Water	Plant is wilted and soil is extremely wet. Roots appear soft and brown. Leaves may become soft and mushy and curl.	Overwatering	Apply water less frequently and in smaller amounts. May need to replace waterlogged soil.
	Plant is wilted, edges of leaves may be brown. Soil is very dry; new leaves are distorted.	Underwatering	Water more frequently without changing the amount applied.

INFORMATION SHEET

FACTOR	SYMPTOMS	CAUSE	SOLUTION
Humidity	Plant leaf edges are turning brown. New growth is weak and distorted.	Too low humidity	Move plant to area with higher humidity. May need to place pot on a shallow pan of rocks with water in it to increase humidity. (NOTE: Plants such as ferns are more sensitive to humidity than others. For these symptoms, first check light, temperature, and water.)
	Soft, dark areas appear on the leaves. Leaves and stems may become soft, mushy and eventually rot. Soil is not waterlogged.	Too high humidity	Decrease humidity. May need to move plant to new location.

(NOTE: Cultural and nutritional factors may interact to produce symptoms similar to those described here.)

INFORMATION SHEET

XI. Macronutrients and micronutrients needed for plant growth

A. Macronutrients

1. Nitrogen (N)
2. Phosphorus (P)
3. Potassium (K)

B. Micronutrients

1. Calcium (Ca)
2. Sulfur (S)
3. Magnesium (Mg)
4. Iron (Fe)
5. Manganese (Mn)
6. Zinc (Zn)
7. Copper (Cu)
8. Boron (B)
9. Molybdenum (Mo)

XII. Symptoms of nutritional deficiencies

(NOTE: Nutritional problems may interact to produce the symptoms described here.)

ELEMENT	DEFICIENCY SYMPTOMS
MACRONUTRIENTS	
Nitrogen	Leaves become light green and growth is stunted. Plant begins to yellow at bottom while top remains green. Yellowing begins at leaf tip and works back to the petiole. (NOTE: Symptoms of nitrogen toxicity are: Plant produces all leaves and stems; does not flower or fruit; heavy application may cause top burn.)

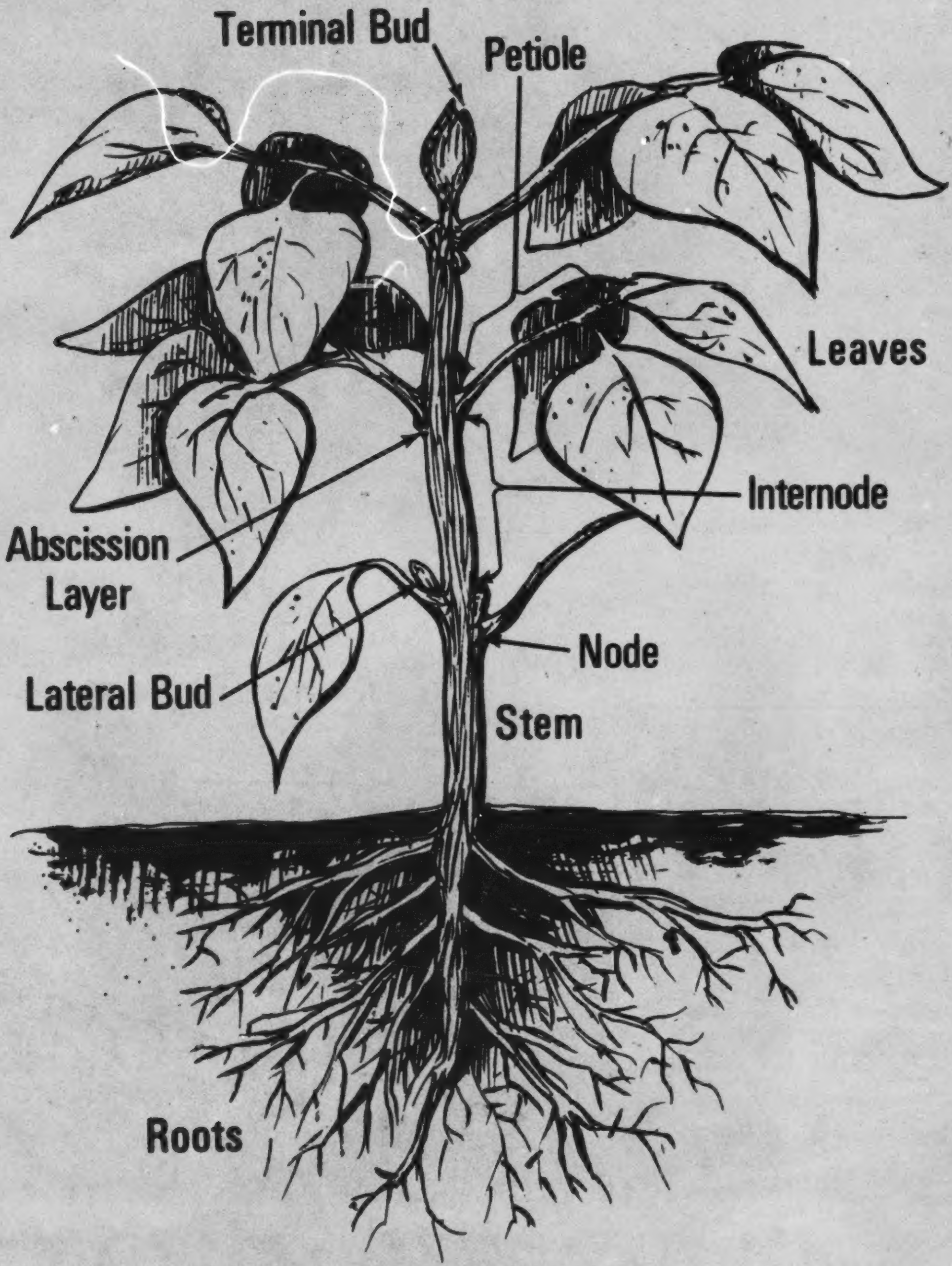
INFORMATION SHEET

ELEMENT	DEFICIENCY SYMPTOMS
Phosphorus	Internodes are short; foliage turns purple or dark green. Older leaves die, flowering is poor.
Potassium	Stems are weak; leaf tips show brown areas; foliage may be mottled. Fruit is small and shriveled.
MICRONUTRIENTS	
Calcium	Young leaves turn yellow and then brown. Stems are weak, growth is stunted. Growing tip bends.
Sulfur	Lower leaves are yellow; stems and roots are narrow; stems are brittle and break easily
Magnesium	Leaves are yellow between veins of leaf; Yellowing begins at bottom of plant. Leaves are thin and tend to curl upward. (NOTE: Strong light causes Mg deficiency.)
Iron	Young leaves are yellow between veins while veins remain green. Symptoms appear first on new growth. (NOTE: High levels of Mn may cause Fe deficiency.)
Manganese	Plant growth is stunted; leaves have white spots appearing between veins. Leaves have dead spots. (NOTE: Strong light may cause Mn deficiency.)
Zinc	Buds are poorly formed; new growth is very small and clustered at end of stem. Leaves have dead areas.
Copper	New growth dies back. Leaves have a bleached appearance.
Boron	Tip of growing point dies; buds are light green, no flower formation. Roots have brown center. (NOTE: Amount of boron is critical; toxicity causes instant death.)

INFORMATION SHEET

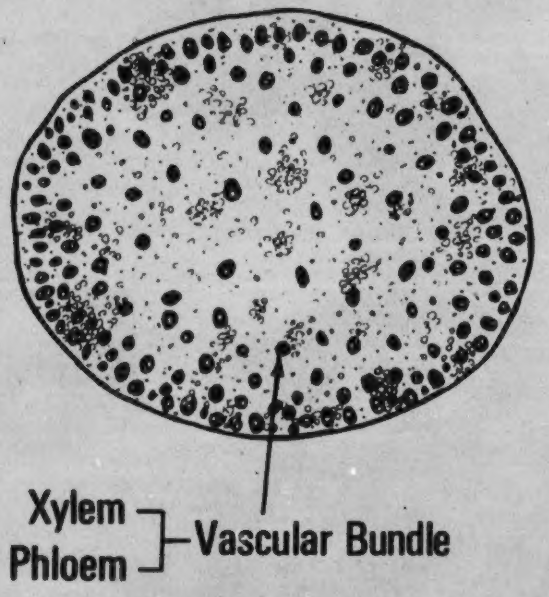
ELEMENT	DEFICIENCY SYMPTOMS
Molybdenum	Plant is very stunted; displays overall pale appearance; turning yellow. (NOTE: Strong light may cause Mo deficiency.)

Parts of Plant

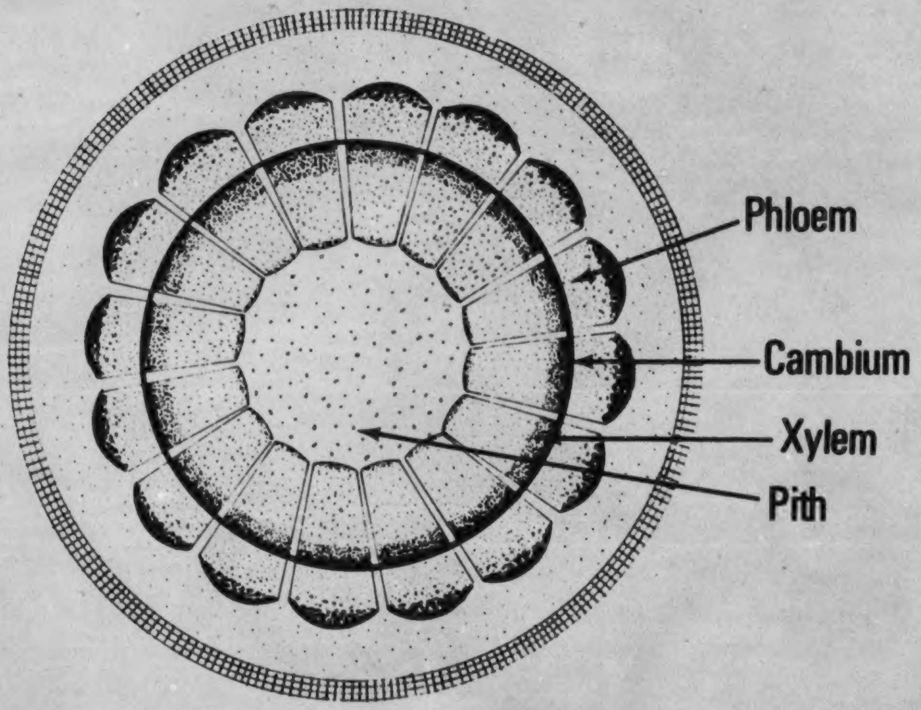

Terminal Bud
Petiole
Leaves
Internode
Abscission Layer
Lateral Bud
Node
Stem
Roots

Vascular Systems

Monocot

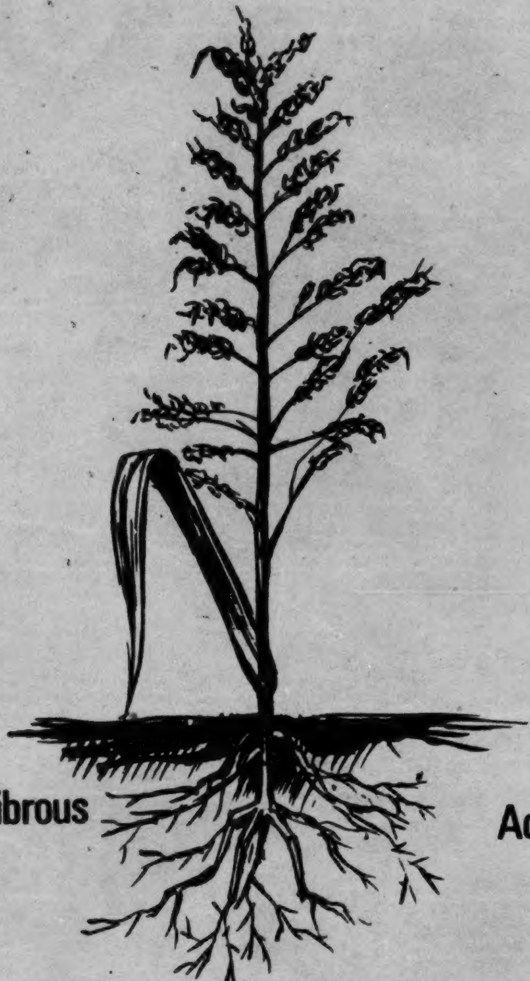

Xylem
Phloem
Vascular Bundle

Dicot

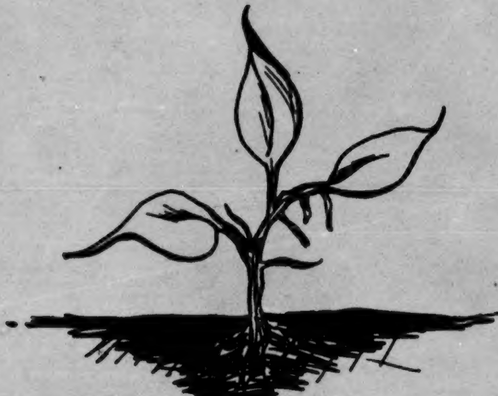

Phloem
Cambium
Xylem
Pith

From *The Nursery Worker Part 1: Basic Plant and Soil Science* by Charles E. Urbanic rev. 1973 by the Ohio Agricultural Education Curriculum Materials Service, The Ohio State University.

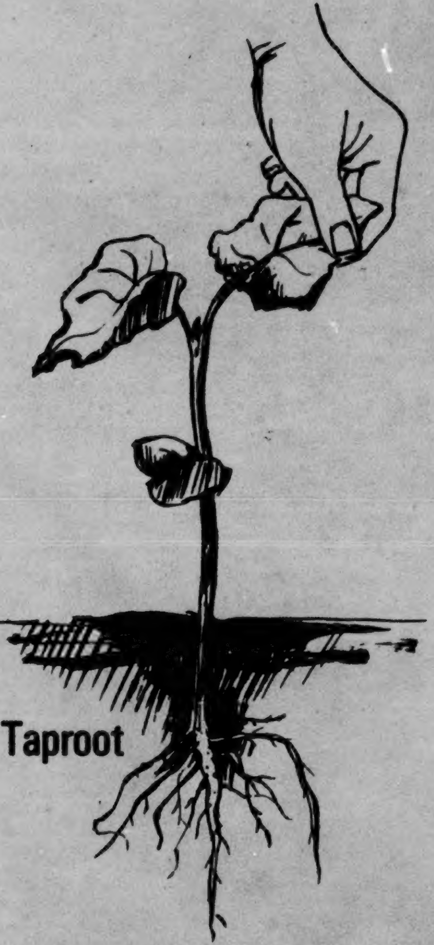
Root Systems



Fibrous

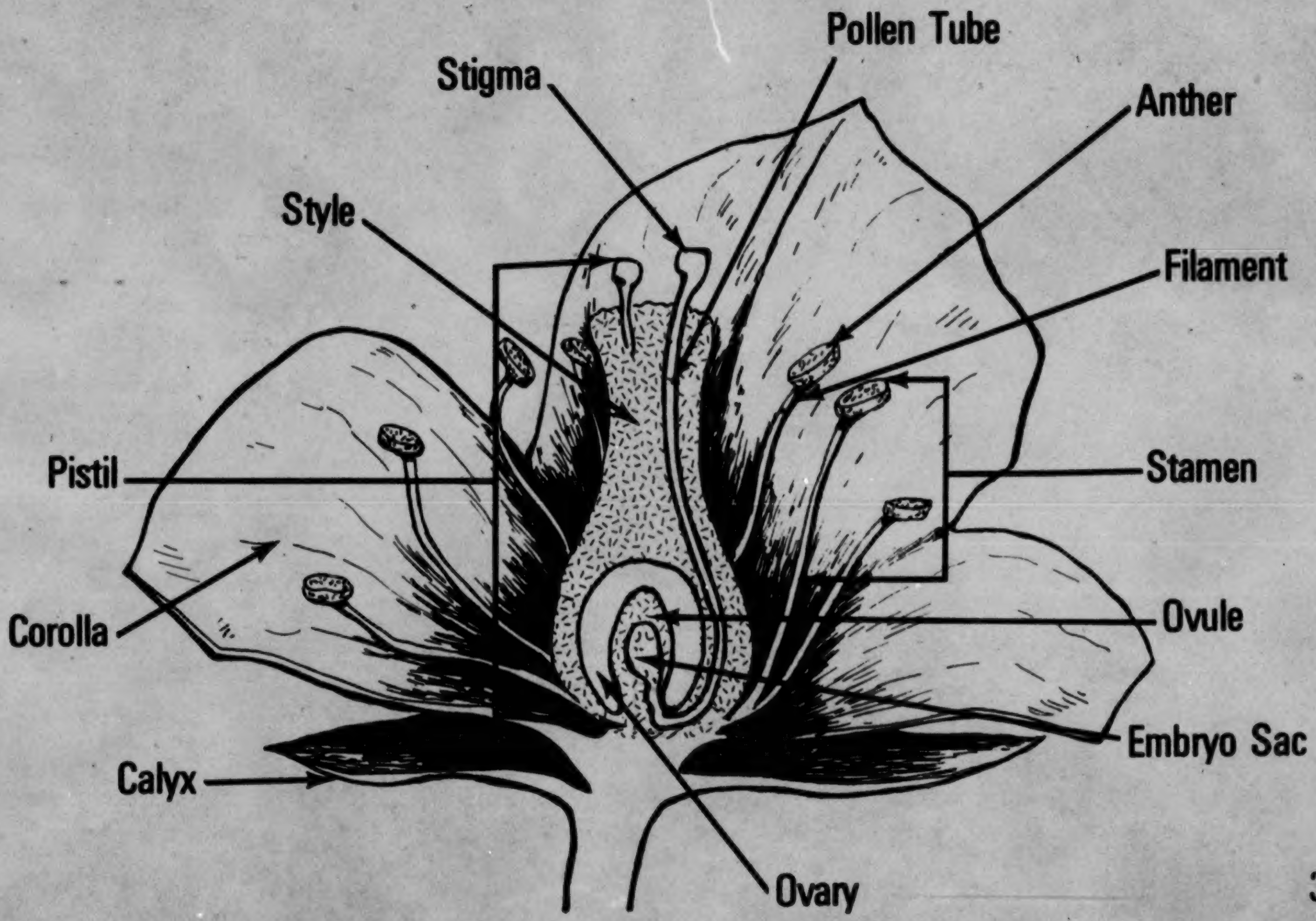


Adventitious

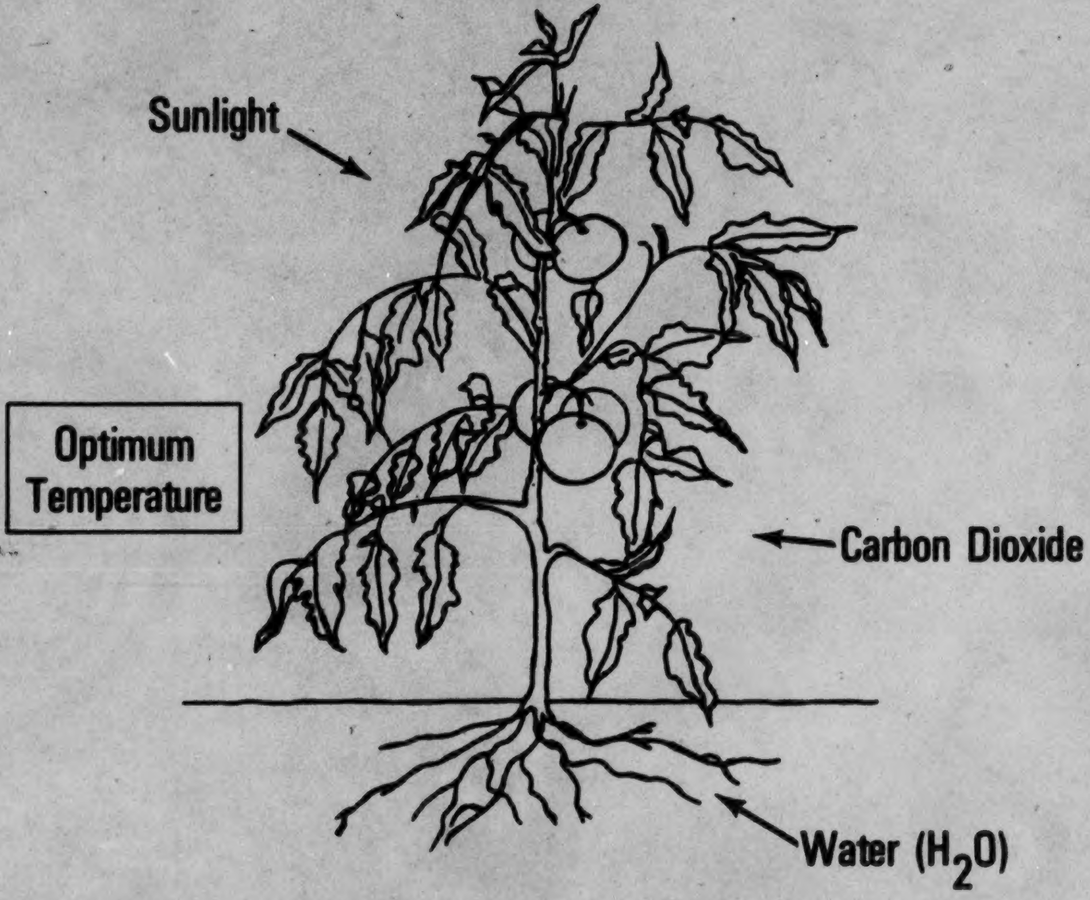


Taproot

Parts of a Flower


Pollen Tube
Stigma
Anther
Style
Filament
Pistil
Stamen
Corolla
Ovule
Embryo Sac
Calyx
Ovary

Photosynthesis


Sunlight
Optimum Temperature
Carbon Dioxide
Water (H_2O)

Photosynthesis

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Respiration

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{energy}$$

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PLANT GROWTH AND RESPONSES
UNIT I

ASSIGNMENT SHEET #1--LABEL PRIMARY PARTS OF A PLANT

NAME____ SCORE__________________

Practice your knowledge of plants by labeling the primary parts of plants shown to you by your instructor. Locate the following parts, if possible.

Leaves
Roots
Node
Abscission layer

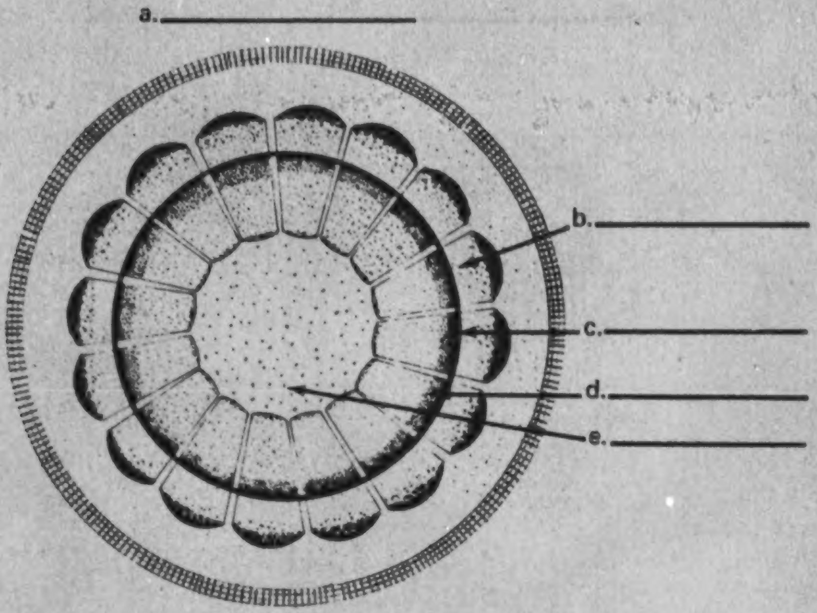
Stem
Terminal bud
Auxiliary bud
Internode
Petiole

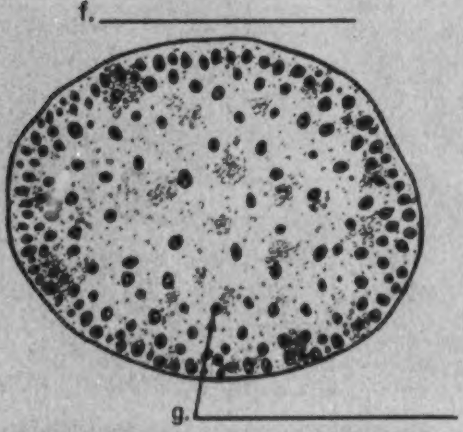
PLANT GROWTH AND RESPONSES
UNIT I

ASSIGNMENT SHEET #2--LABEL VASCULAR SYSTEMS OF MONOCOTS AND DICOTS

NAME____________________________________ SCORE________________

Practice labeling the vascular systems of the monocot and dicot shown below.





From *The Nursery Worker Part 1: Basic Plant and Soil Science* by Charles E. Urbanic. rev. 1973 by the Ohio Agricultural Education Curriculum Materials Service, The Ohio State University.

PLANT GROWTH AND RESPONSES
UNIT I

ASSIGNMENT SHEET #3--LABEL PRIMARY PARTS OF A COMPLETE FLOWER

NAME______________________________ SCORE______________

Label primary parts of complete flowers shown to you by your instructor. Locate the following parts.

Pistil
Corolla
Calyx
Stamen
Anther
Filament
Pollen tube
Ovule
Embryo Sac
Stigma
Style
Ovary

PLANT GROWTH AND RESPONSES
UNIT I

ASSIGNMENT SHEET #4--RECOMMEND SOLUTIONS TO ENVIRONMENTAL PROBLEMS

NAME________________________________ SCORE________________

As a horticulturist, you will be called upon frequently to diagnose plant problems. Analyze the situations below and state what you believe to be the most likely environmental problem. Then recommend steps to remedy it.

1. Mr. Jones has a philodendron that has become lanky. The color is not as dark a green as it was originally. The plant is located about 25 ft. from an east window.

   a. Problem:

   b. Solution:

2. You purchased a new Boston fern 3 weeks ago. Gradually you notice that the tops and edges of the leaflets are beginning to turn brown. New leaves seem weak.

   a. Problem:

   b. Solution:

ASSIGNMENT SHEET #4

3. Your favorite Swedish ivy has a bleached look to its leaves. The internodes are very short and you notice some brown patches occurring on the leaves.

   a. Problem:

   b. Solution:

4. Mrs. Davis has an ivy plant that has begun to turn mushy and brown on the tips of the leaves. She carried it in from the car on a fairly windy day but the temperature was only in the mid-40° range.

   a. Problem:

   b. Solution:

ASSIGNMENT SHEET #4

5. The leaves on your dogwood tree are turning brown and curling on the edges. New leaves are distorted and the soil seems dry.

   a. Problem:

   b. Solution

6. The junipers you planted around the base of your pecan tree are pale green and thin.

   a. Problem:

   b. Solution:

PLANT GROWTH AND RESPONSES
UNIT I

ASSIGNMENT SHEET #5--RECOGNIZE NUTRITIONAL PROBLEMS FROM THEIR SYMPTOMS

NAME ______________________________ SCORE ______________

Identify the following nutritional problems from their descriptions. Write what nutrient is causing the problem in the blanks provided. Indicate toxicity with an asterisk (*) beside your answer.

A. ____________________ Internodes are short, older leaves have died, flowers are small and few in number, and the foliage has a purplish tint.

B. ____________________ Plants with this problem have stems which break easily and are very narrow. The lower leaves of the plant will be yellowing and, when roots are checked, they appear to be small in size.

C. ____________________ The buds on your plant are very small and the new growth is clustered toward the ends of the stems. There are also dead areas appearing on the leaves.

D. ____________________ Your African violet has not bloomed all season. The leaves are a nice, dark green color, and the plant has been growing a great deal.

E. ____________________ Your peach tree flowered this year but the fruit produced is very small and shriveled. New stems are weak and there are brown tips on the leaves as well as a mottled appearance.

F. ____________________ Your pin oak has begun to turn yellow between the veins. The top of the tree shows the worst symptoms.

G. ____________________ Much of your cotton crop seems stunted. The leaves have white spots between the veins and some dead spots appear.

H. ____________________ You have just applied a micronutrient mix to your poinsettias. Within a week all your plants are dead.

I. ____________________ The leaves of your plant are yellow between the veins, beginning at the bottom of the plant. The leaves are also thin and curl upward. The plant is in strong light.

J. ____________________ The growing tip of your zebra plant bends down, and the young leaves have turned yellow and then brown.

K. ____________________ A mum plant is very stunted and displays an overall pale appearance, turning yellow.

L. ____________________ The leaves of your plant have a bleached appearance and new growth dies back.

PLANT GROWTH AND RESPONSES
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #2

a. Dicot

b. Phloem

c. Cambium

d. Xylem

e. Pith

f. Monocot

g. Vascular bundle

Assignment Sheet #4

1. a. Too low light

   b. Gradually move to higher light location

2. a. Low humidity

   b. Place a pan of shallow rocks with water; a move to higher humidity location

3. a. Too much light

   b. Move to lower light location

4. a. Cold damage

   b. Remove damaged parts and maintain proper temperatures

5. a. Too little water

   b. Water more frequently or in larger amounts

6. a. Too low light

   b. Move to higher light area; select plants more adaptable to low light

Assignment Sheet #5

a. Phosphorus

b. Sulfur

c. Zinc

d. Nitrogen*

e. Potassium

f. Iron

g. Manganese

h. Boron*

i. Magnesium

j. Calcium

k. Molybdenum

l. Copper

PLANT GROWTH AND RESPONSES
UNIT I

TEST

NAME________________________________ SCORE______________

1. Match terms associated with plant processes to the correct definitions. Write the correct numbers in the blanks provided.

_____a. The stem of a leaf

_____b. Any bud found growing at the tip of a stem

_____c. Joint where both leaves and buds appear on stem

_____d. Vertical, deep penetrating central root with few laterals

_____e. Bud appearing on the side of a stem, usually at a node

_____f. Greatly branched root system without a dominant root

_____g. Portion of a stem between nodes

_____h. Flower containing all reproductive parts

_____i. Flower containing either pistil or stamens

_____j. Plant with one cotyledon in its seed

_____k. Part of plant which transports food from leaves to other parts of plant

_____l. Manufacture of carbohydrates in green plants from carbon dioxide and water

_____m. Part of plant that transfers water up from roots to leaves

_____n. Plant with two cotyledons in its seed

_____o. Green coloring matter found in plants

_____p. Nutrient needed by plant in large quantities

_____q. Narrow layer of cells in vascular system of dicots that eventually becomes bark and lays down wood tissue

1. Petiole
2. Internode
3. Taproot system
4. Lateral bud
5. Complete flower
6. Fibrous root system
7. Terminal bud
8. Node
9. Incomplete flower
10. Cotyledon
11. Transpiration
12. Photosynthesis
13. Chlorophyll
14. Cambium
15. Monocot
16. Phloem
17. Xylem
18. Macronutrient
19. Dicot

______r. Nutrients needed by plant in small quantities

______s. Xylem and phloem combined; transport water and nutrients within the plant

______t. Embyonic seed leaf, easily seen in large seeds

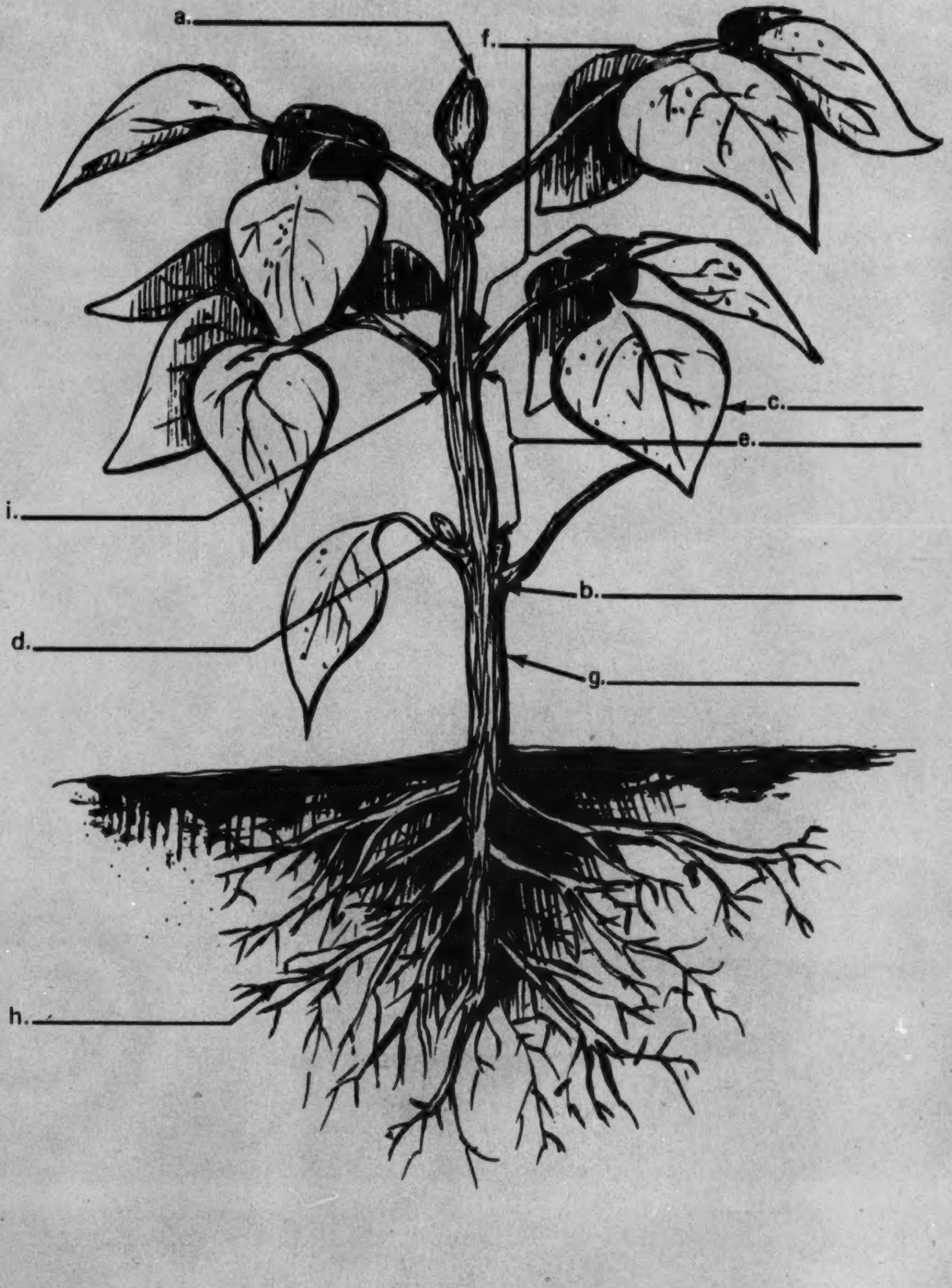
______u. Loss of water vapor from leaf surface

______v. Corky center of the stem of dicots

______w. Opposite of photosynthesis; energy is used by plant, resulting in water and carbon dioxide

20. Vascular system
21. Micronutrient
22. Transpiration
23. Cotyledon
24. Respiration
25. Pith

2. Label the primary parts of the plant shown below. Write the correct names in the blanks provided.



3. Match plant processes to their descriptions. Write the correct numbers in the blanks provided.

_____ a. Serves as an anchor; supports upper plant; absorbs water and nutrients; stores food

_____ b. Supports plant and leaves; transports food and water to other portions of plant; stores food

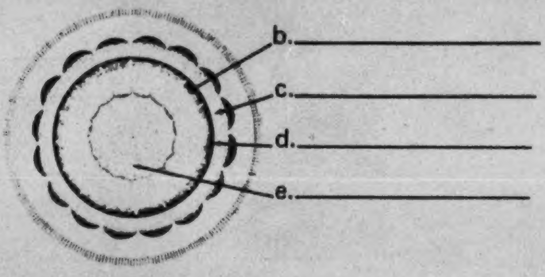
_____ c. Manufactures food for plant; stores food; controls transpiration of plant

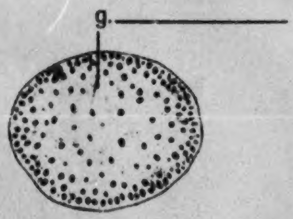
_____ d. Stores food; serves as a growth site

_____ e. Site of seed formation

1. Flower
2. Stem
3. Root
4. Leaf
5. Bud

4. Label the two types of vascular systems in the drawings shown below. Write the correct names in the blanks provided.

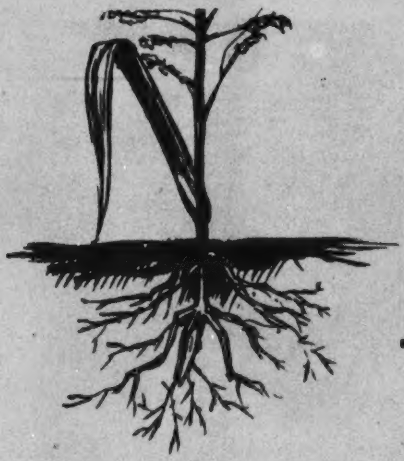


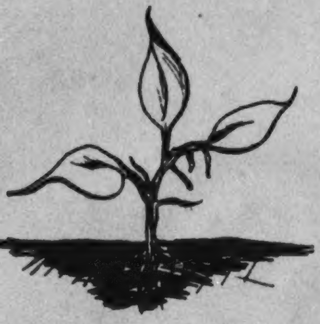


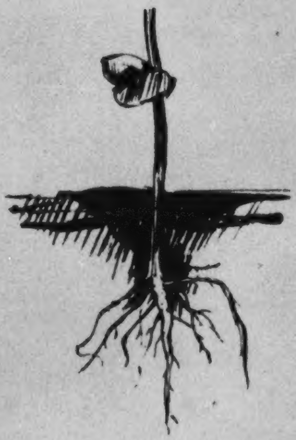
a. Type of plant: ______________

f. Type of plant: ______________

5. Label the three types of root systems. Write the correct names in the blanks provided.





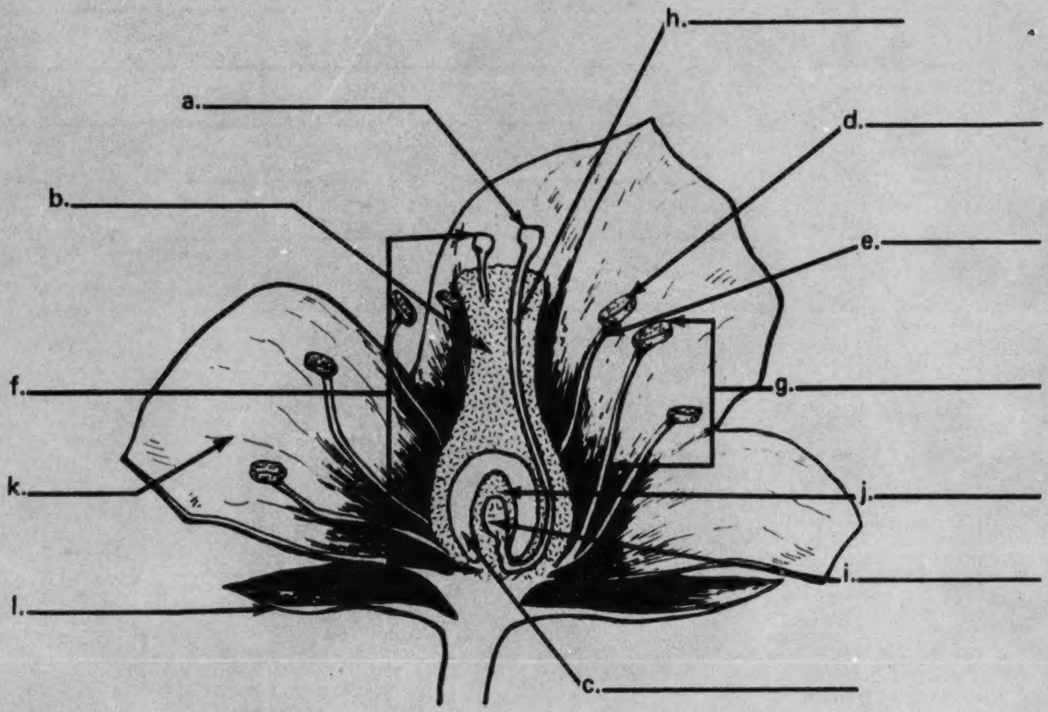


a. ______________

b. ______________

c. ______________

6. Label the parts of a complete flower in the blanks provided.



7. Arrange in order steps in photosynthesis. Write a "1" for the first step, a "2" for the second step, and so on.

_____a. Water (H_2O) is absorbed by roots

_____b. Sugars are converted to starches and stored

_____c. $6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$

_____d. Carbon dioxide (CO_2) is absorbed by leaves

_____e. Starches can be converted back to sugar to be used in protein, fats, or as energy

8. Write the formula for respiration.

____

____

9. Name the cultural and environmental factors which affect plant growth.

a. ____

b. ____

c. ____

d. ____

e. ____

10. Complete the chart below of symptoms associated with environmental problems. Write the correct answers in the blanks provided.

FACTOR	SYMPTOMS	CAUSE	SOLUTION
Light	Plant is "stretching." Stem is elongated between leaves. Color is pale green. Outdoor plants may thin out from too much shade.	Too low light	a. ______________________ ______________________ ______________________
	Leaves are very close together. Brown patches are appearing on leaves and color is bleached. Tips of leaves may be browning.	b. ______	Move gradually to area with lower light
Temperature	c. ______________________ ______________________ ______________________	Cold damage	Maintain proper temperatures. Remove damaged parts.
	Plant wilts quickly. On flowering plants, flowers are bleached. Some plants may show browning on leaf edge.	Temperatures too high	d. ______________________ ______________________ ______________________
Water	Plant is wilted and soil is extremely wet. Roots appear soft and brown. Leaves may become soft and mushy and curl.	Overwatering	e. ______________________ ______________________ ______________________
	f. ______________________ ______________________ ______________________	Underwatering	Water more frequently without changing the amount applied.

FACTOR	SYMPTOMS	CAUSE	SOLUTION
Humidity	Plant leaf edges are turning brown. New growth is weak and distorted.	g. ______	Move plant to area with higher humidity. May need to place pot on a shallow pan of rocks with water in it to increase humidity.
	Soft, dark areas appear on the leaves. Leaves and stems may become soft, mushy and eventually rot. Soil is not waterlogged.	Too high humidity.	h. ______ ______ ______

11. Distinguish between macronutrients and micronutrients needed for plant growth. Write an "A" for macronutrients and an "I" for micronutrients.

______a. Molybdenum
______b. Sulfur
______c. Nitrogen
______d. Zinc
______e. Phosphorus
______f. Manganese
______g. Calcium
______h. Copper
______i. Iron
______j. Boron
______k. Magnesium
______l. Potassium

12. Match symptoms of nutritional deficiencies to their causes. Write the correct numbers in the blanks provided. Terms are continued on the next page.

______a. Internodes are short; foliage turns purple or dark green. Older leaves die; flowering is poor

______b. Lower leaves are yellow; stems and roots are narrow; stems are brittle and break easily

______c. Leaves become light green and growth is stunted. Plant begins to yellow at bottom while top remains green. Yellowing begins at leaf tip and works back to the petiole

______d. Young leaves turn yellow and then brown. Stems are weak, growth is stunted. Growing tip bends

______e. Stems are weak; leaf tips show brown areas; foliage may be mottled. Fruit is small and shriveled

______f. New growth dies back. Leaves have a bleached appearance

______g. Plant growth is stunted; leaves have white spots appearing between veins. Leaves have dead spots

______h. Leaves are yellow between veins of leaf; yellowing begins at bottom of plant. Leaves are thin and tend to curl upward

______i. Plant is very stunted; displays overall pale appearance; turning yellow

______j. Tip of growing point dies; buds are light green, no flower formation. Roots have brown center

1. Nitrogen
2. Phosphorus
3. Potassium
4. Calcium
5. Sulfur
6. Magnesium
7. Iron
8. Manganese
9. Zinc
10. Copper
11. Boron
12. Molybdenum

_____k. Buds are poorly formed; new growth is very small and clustered at end of stem; leaves have dead areas

_____l. Young leaves are yellow between veins while veins remain green. Symptoms appear first on new growth

13. Recommend solutions to environmental problems.

14. Recognize nutritional problems from their symptoms.

(NOTE: If activities 13 and 14 have not been finished before the test, ask your instructor when they should be completed.)

PLANT GROWTH AND RESPONSES
UNIT I

ANSWERS TO TEST

1. a. 1
   b. 7
   c. 8
   d. 3
   e. 4
   f. 6
   g. 2
   h. 5
   i. 9
   j. 15
   k. 16
   l. 12
   m. 17
   n. 19
   o. 13
   p. 18
   q. 14
   r. 21
   s. 20
   t. 23
   u. 22
   v. 25
   w. 24

2. a. Terminal bud
   b. Node
   c. Leaves
   d. Lateral bud
   e. Internode
   f. Petiole
   g. Stem
   h. Roots
   i. Abscission layer

3. a. 3
   b. 2
   c. 4
   d. 5
   e. 1

50-A

4. a. Dicot
   b. Xylem
   c. Phloem
   d. Cambium
   e. Pith
   f. Monocot
   g. Vascular bundle

5. a. Fibrous
   b. Adventitious
   c. Taproot

6. a. Stigma
   b. Style
   c. Ovary
   d. Anther
   e. Filament
   f. Pistil
   g. Stamen
   h. Pollen tube
   i. Embryo sac
   j. Ovule
   k. Corolla
   l. Calyx

7. a. 2
   b. 4
   c. 3
   d. 1
   e. 5

8. $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$ + energy

9. a. Light
   b. Humidity
   c. Temperature
   d. Nutrition
   e. Water

10. a. Move gradually to area with more light
    b. Too much light
    c. Leaves are soft, mushy, and quickly turn brown or black. May occur only on leaf tips

d. Lower temperatures to recommended range

e. Apply water less frequently and in smaller amounts. May need to replace waterlogged soil.

f. Plant is wilted, edges of leaves may be brown. Soil is very dry; new leaves are distorted

g. Too low humidity

h. Decrease humidity. May need to move plant to new location

11. a. I
b. I
c. A
d. I
e. A
f. I
g. I
h. I
i. I
j. I
k. I
l. A

12. a. 2
b. 5
c. 1
d. 4
e. 3
f. 10
g. 8
h. 6
i. 12
j. 11
k. 9
l. 7

13. Evaluated to satisfaction of instructor

14. Evaluated to satisfaction of instructor

PLANT GROWTH REGULATORS
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to demonstrate the ability to control plant growth through proper selection and application of growth regulators. This knowledge will be evidenced through completion of job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with plant growth regulators to the correct definitions.
2. List types of plant growth regulators.
3. Match growth regulators with their effects on plants.
4. Discuss methods of applying exogenous hormones.
5. Discuss general problems of growth retardant application.
6. Demonstrate the ability to:
    a. Mix and apply a foliar growth retardant.
    b. Mix and apply a soil drench growth retardant.
    c. Compare growth retardant rates.

PLANT GROWTH REGULATORS
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Use several different types of growth retardants on similar plants to compare effectiveness.

   G. Give test.

   H. Reteach if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Job sheets

      1. Job Sheet #1--Mix and Apply a Foliar Growth Retardant

      2. Job Sheet #2--Mix and Apply a Soil Drench Growth Retardant

      3. Job Sheet #3--Compare Growth Retardant Rates

   D. Test

   E. Answers to test

III. Unit references:

   A. Laurie, A.; Kiplinger, D.C.; and Nelson, K.S. *Commercial Flower Forcing.* 7th ed. New York: McGraw-Hill Book Company, 1968.

   B. Mastalerz, J.W. *The Greenhouse Environment.* New York: John Wiley and Sons, 1977.

PLANT GROWTH REGULATORS
UNIT II

INFORMATION SHEET

I. Terms and definitions

  A. Indogenous–Found within the plant

  B. Exogenous--Applied outside the plant

  C. Growth retardant--Chemical applied to plant to halt further development

  D. Rooting hormone--Liquid or powder solution applied to new cuttings to promote rooting

  E. Auxin–Hormone produced in tips of stems or roots which affects shoot dominance

  F. Gibberellin–Hormone produced throughout plant which causes cell elongation

  G. Emulsifiable concentrate--Concentrated chemical solution that must be mixed with water before application

  H. Wettable powder--Concentrated, dry form of a chemical that must be mixed with water before application

  I. Cytokinin–Hormone produced in plant that promotes cell division and stimulates lateral growth

  J. Cultivar--A single propagatable type of plant

II. Types of plant growth regulators

  A. Exogenous

    1. Growth retardants

    2. Rooting hormones

  B. Indogenous

    1. Auxins

    2. Gibberellins

    3. Cytokinins

INFORMATION SHEET

III. Growth regulators and their effects on plants

Type of Regulator	Effect on Plant
A. Exogenous 1. Growth retardants	Prevent lengthening of internodes Darken foliage Leaves appear thicker but are thinner
2. Rooting hormones	Stimulate root development
B. Indogenous 1. Auxins	Promote cell elongation Inhibit shoot development and apical dominance
2. Gibberellins	Promote cell elongation throughout plant
3. Cytokinins	Promote cell division Stimulate lateral growth

IV. Methods of applying exogenous hormones

A. Foliar spray

1. Uses wettable powder or emulsifiable concentrate
2. Applied to upper surface of leaves as a fine mist from a sprayer to the point of runoff

B. Soil drench

1. Uses wettable powder or emulsifiable concentrate
2. Applied directly to the soil

V. General problems of growth retardant application

A. Foliar sprays may damage leaves

B. Early applications of retardant may make repeated applications necessary

INFORMATION SHEET

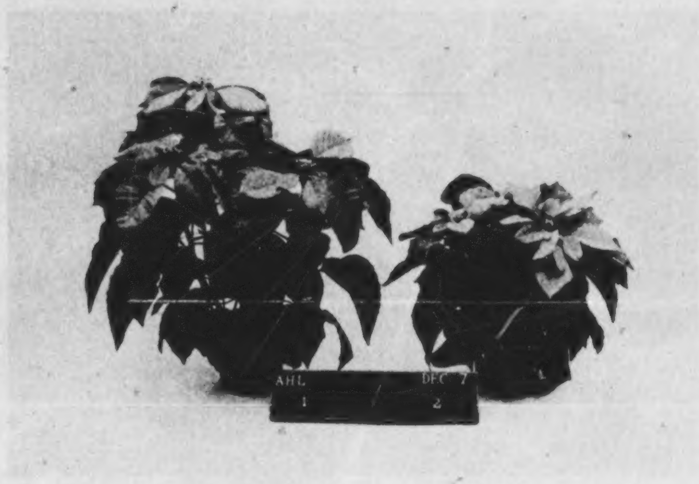
C. Soil drench is more expensive to apply

(NOTE: Soil drench takes more labor, and higher concentrations of chemicals are needed.)

D. Effectiveness of retardant depends on species and cultivar of plant treated

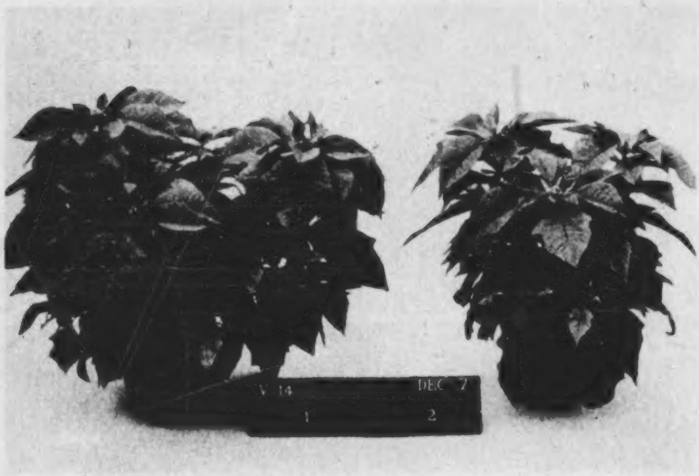
Examples:

FIGURE 1



'Annette Hegg Lady' -- Growth retardant spray caused reduction in height of plant on the right.

FIGURE 2



'Gutbier V-14 Glory' -- Growth retardant spray has little effect on plant on the right.

PLANT GROWTH REGULATORS
UNIT II

JOB SHEET #1--MIX AND APPLY A FOLIAR GROWTH RETARDANT

I. Materials

- A. Growth retardant--Liquid or powder

  (NOTE: Read retardant label to determine proper rate of application.)

- B. Calibrated beaker
- C. Stir rod
- D. Sprayer
- E. Water
- F. Two similar plants

II. Procedure

- A. Measure out retardant
- B. Add to proper amount of water

  (NOTE: Check label for proper amount of water.)

- C. Mix thoroughly

  (NOTE: This step is very important to insure even coverage.)

- D. Add to sprayer
- E. Spray upper surface of leaves of one plant to the point of runoff
- F. Take weekly measurements of plants for one month; observe difference in heights

	Plant Treated	Plant Untreated
Height on day of application (cms.)		
After 1 week		
After 2 weeks		
After 3 weeks		
After one month		
Total difference in height (cms.)		

PLANT GROWTH REGULATORS
UNIT II

JOB SHEET #2--MIX AND APPLY A SOIL DRENCH GROWTH RETARDANT

I. Materials

   A. Growth retardant--Liquid or powder

      (NOTE: Read retardant label to determine proper rate of application.)

   B. Calibrated beaker

   C. Stir rod

   D. Water

   E. Two similar plants

II. Procedure

   A. Measure out retardant

   B. Add to proper amount of water

      (NOTE: Check label for proper amount of water.)

   C. Mix thoroughly

      (NOTE: This step is very important to insure even coverage.)

   D. Measure out recommended rate per pot

   E. Apply evenly to upper soil surface of one plant

      (CAUTION: Soil drench should be applied only after the plants have been watered. Application to dry soil may cause root damage.)

   F. Take weekly measurements of the two plants

	Treated Plant	Untreated Plant
Height on day of application (cms.)		
After 1 week		
After 2 weeks		
After 3 weeks		
After one month		
Total difference in height (cms.)		

PLANT GROWTH REGULATORS
UNIT II

JOB SHEET #3--COMPARE GROWTH RETARDANT RATES

I. Materials

  A. Growth retardant--Liquid or powder

  (NOTE: Read retardant label to determine proper rate of application.)

  B. Three plants of the same variety

  C. Three jars for mixing retardant

  D. Water

II. Procedure

  A. Measure out retardant

    1. Half rate in first jar

    2. Recommended rate in second jar

    3. Double rate in third jar

  B. Add retardant to proper amount of water

  C. Mix thoroughly

  D. Add recommended amount of the solution using recommended method

  E. Label plants with rate of retardant applied

  F. Take weekly measurements and make other observations

Rate	Height (cms)				Observations
	Wk. 1	Wk. 2	Wk. 3	Wk. 4	
Half rate					
Recommended rate					
Double rate					

PLANT GROWTH REGULATORS
UNIT II

TEST

NAME________________________________ SCORE____________________

1. Match terms associated with plant growth regulators to the correct definitions. Write the correct numbers in the blanks provided.

______a. Chemical applied to plant to halt further development

______b. Hormone produced throughout plant which causes cell elongation

______c. Concentrated, dry form of a chemical that must be mixed with water before application

______d. Applied outside the plant

______e. Concentrated chemical solution that must be mixed with water before application

______f. Found within the plant

______g. Hormone produced in tips of stems or roots which affects shoot dominance

______h. Liquid or powder solution applied to new cuttings to promote rooting

______i. Hormone produced in plant that promotes cell division and stimulates lateral growth

______j. A single propagatable type of plant

1. Rooting hormone
2. Emulsifiable concentrate
3. Gibberellin
4. Wettable powder
5. Indogenous
6. Auxin
7. Growth retardant
8. Exogenous
9. Cytokinin
10. Cultivar

2. List types of plant growth regulators.

Exogenous	Indogenous
____________________	____________________
____________________	____________________
____________________	____________________

3. Match growth regulators with their effects on plants. Write the correct names in the blanks provided.

Auxins
Cytokinins
Growth retardants
Gibberellins
Rooting hormones

a. ______________________ Stimulate root development

b. ______________________ Promote cell elongation throughout plant

c. ______________________ Prevent lengthening of internodes; darken foliage; leaves appear thicker but are thinner

d. ______________________ Promote cell elongation; inhibit shoot development and apical dominance

e. ______________________ Promote cell division; stimulate lateral growth

4. Discuss methods of applying exogenous hormones.

5. Discuss general problems of growth retardant application.

6. Demonstrate the ability to:

a. Mix and apply a foliar growth retardant.

b. Mix and apply a soil drench growth retardant.

c. Compare growth retardant rates.

(NOTE: If the above activities have not been finished before the test, ask your instructor when they should be completed.)

PLANT GROWTH REGULATORS
UNIT II

ANSWERS TO TEST

1. a. 7
   b. 3
   c. 4
   d. 8
   e. 2
   f. 5
   g. 6
   h. 1
   i. 9
   j. 10

2.

Exogenous	Indogenous
Rooting hormones	Auxins
Growth retardants	Gibberellins
	Cytokinins

3. a. Rooting hormones
   b. Gibberellins
   c. Growth retardants
   d. Auxins
   e. Cytokinins

4. Discussion should include:

   Foliar spray--Uses wettable powder or emulsifiable concentrate; applied to upper surface of leaves as a fine mist from a sprayer to the point of runoff

   Soil drench--Uses wettable powder or emulsifiable concentrate; applied directly to the soil

5. Discussion should include:
   a. Foliar sprays may damage leaves
   b. Early applications of retardant may make repeated applications necessary
   c. Soil drench is more expensive to apply
   d. Effectiveness of retardant depends on species and cultivar of plant treated

6. Performance skills evaluated to satisfaction of instructor

SEXUAL PLANT PROPAGATION
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to demonstrate the ability to propagate seeds by various methods. This knowledge will be evidenced by completion of the job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with sexual propagation to the correct definitions.
2. Identify parts of seedlings.
3. Name methods of seeding.
4. State the reasons for scarification.
5. Describe scarification methods.
6. State the reason for stratification.
7. Demonstrate the ability to:
    a. Seed a flat with fine seeds.
    b. Scarify seeds by file or sandpaper method.
    c. Scarify seeds by acid treatment.
    d. Stratify seeds.

SEXUAL PLANT PROPAGATION
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet and make transparency.

   B. Provide student with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and job sheets.

   E. Grow scarified and non-scarified seeds and compare germination rates.

   F. Compare growth of nonstratified pecans and stratified pecans.

   G. Emphasize hazards of sulfuric acid.

   H. Give test.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Transparency master: TM 1--Parts of Seedlings

   D. Job sheets

      1. Job Sheet #1--Seed a Flat with Fine Seeds

      2. Job Sheet #2--Scarify Seeds by File or Sandpaper Method

      3. Job Sheet #3--Scarify Seeds by Acid Treatment

      4. Job Sheet #4--Stratify Seeds

   E. Test

   F. Answers to test

III. Unit references:

   A. Denisen, E. L. *Principles of Horticulture.* 6th ed. New York: Macmillan Publishing Co., 1958.

   B. Hartmann, H. T. and Kester, D. E. *Plant Propagation Principles and Practices.* 3rd ed. Englewood Cliffs: Prentice-Hall, Inc., 1975.

SEXUAL PLANT PROPAGATION
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Germination--Seed begins to grow

   B. Scarification--Altering the seed coat to allow water penetration into the seed

   C. Embryo--Portion of the seed which develops into a plant

   D. Stratification--Cold treatment given to some types of seeds to complete ripening and overcome dormancy

   E. Dormancy--Rest period required for some seeds in order to germinate; naturally occurs in late fall and winter

   F. Flat--Shallow wooden or plastic container used to sow seeds or grow cuttings

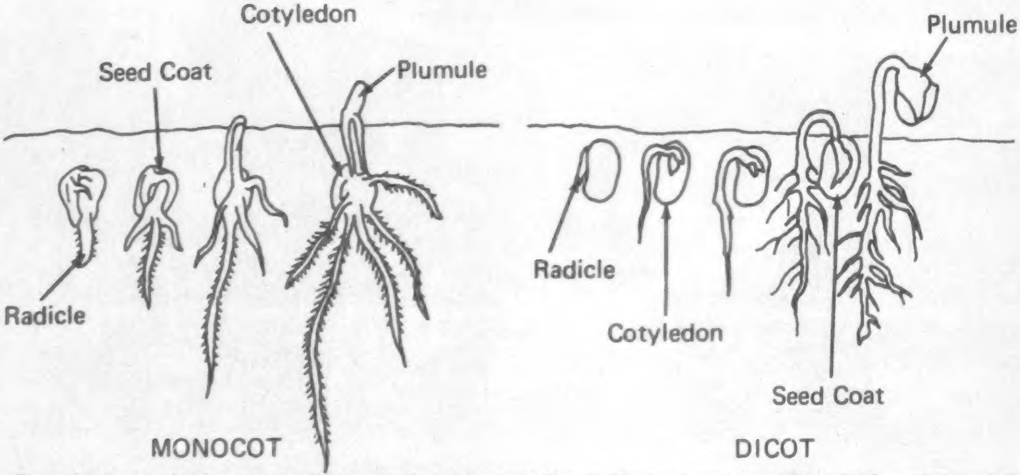
II. Parts of seedlings (Transparency 1)

   A. Plumule

   B. Cotyledon

   C. Radicle

   D. Seed coat


Cotyledon
Seed Coat
Plumule
Radicle
MONOCOT
Plumule
Radicle
Cotyledon
Seed Coat
DICOT

From *Working in Horticulture* by William B. Richardson and Gary E. Moore. Copyright 1980 by McGraw-Hill Book Company. Adapted with permission of McGraw-Hill Book Company.

INFORMATION SHEET

III. Methods of seeding

(NOTE: Good seed selection is very important. Always select varieties recommended for your specific area.)

A. Furrow method-Used for small to medium-sized seeds; seeds are distributed evenly in the furrow and transplanted at a later time

Examples: Periwinkle, petunia

B. Individual seed method-Used for larger seeds; may be used for bedding plants to avoid transplanting later

Examples: Marigold, pecan

IV. Reasons for scarification

A. Breaks the tough seed coat

B. Aids germination

C. Increases water absorption

Examples: Mimosa, redbud, peach

V. Scarification methods

A. Acid treatment--Seeds are placed in sulfuric acid solution for certain length of time to help soften the seed coat

B. File or sandpaper method--Seed coat is notched by filing a small indentation

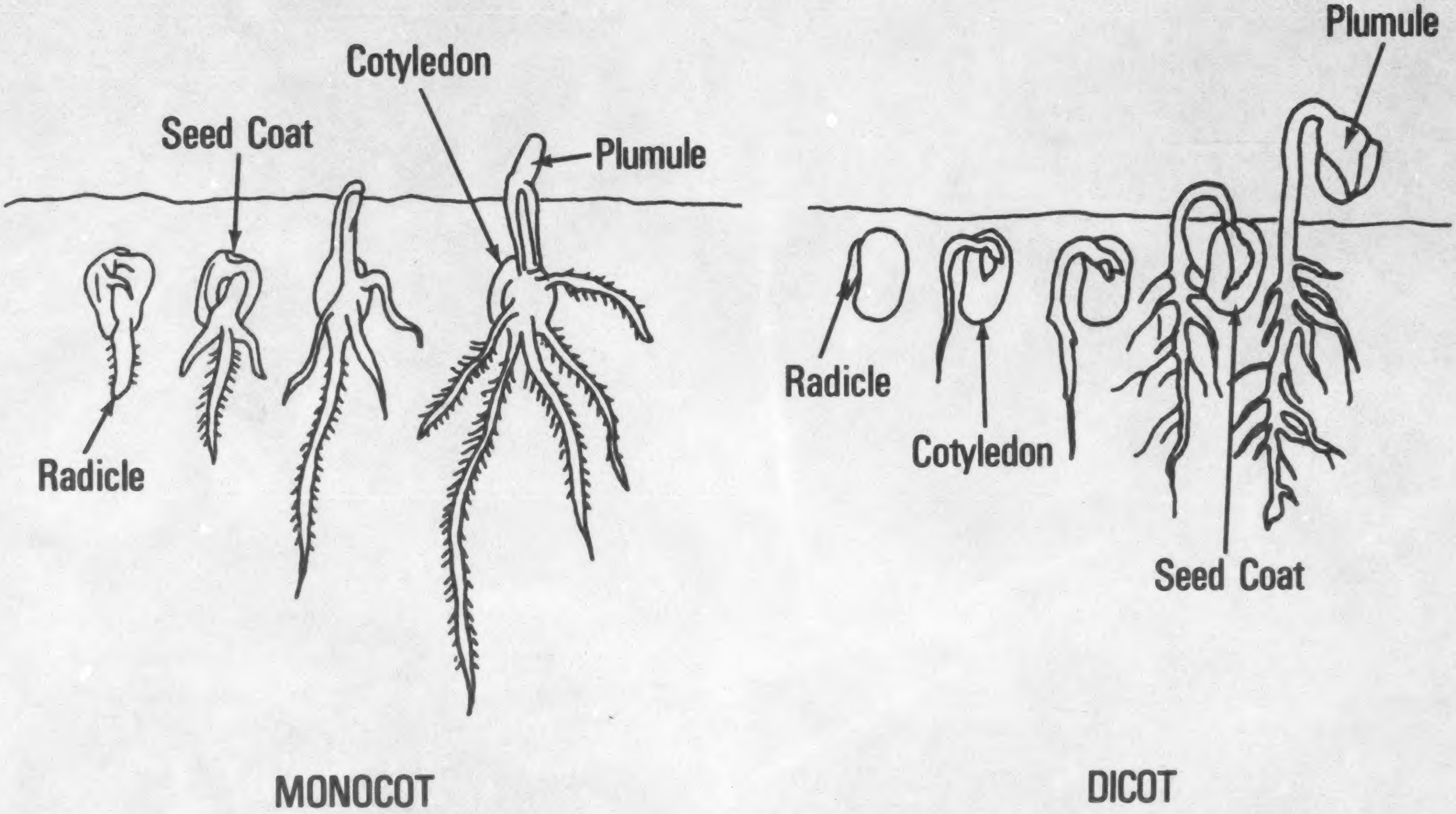
C. Soak method--Seeds are soaked overnight in water

VI. Reason for stratification--Hastens germination by placing seeds in a cold, moist environment to break dormancy

Example: Pecans

(NOTE: Temperatures used are just above freezing; time varies with type of seed.)

Parts of Seedlings


Seed Coat
Cotyledon
Plumule
Radicle
MONOCOT
Radicle
Cotyledon
Plumule
Seed Coat
DICOT

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SEXUAL PLANT PROPAGATION
UNIT I

JOB SHEET #1--SEED A FLAT WITH FINE SEEDS

I. Materials

A. Fine seeds

Examples: Petunia, periwinkle, spinach, tomato

B. Flat

C. Identification stake

D. Stake marker

(NOTE: China markers or pencil must be used on plastic stakes.)

E. Porous soil mixture

Examples: 1 part peat to 1 part perlite, all vermiculite, bagged premix

F. Watering bulb

II. Procedure

(NOTE: Major seed catalogs will give temperatures, planting depth, and other important information for germination.)

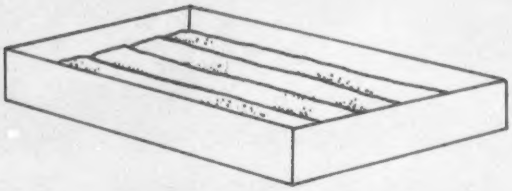
A. Fill the flat with soil

B. Firm soil slightly by patting with palm of hand

(NOTE: Be careful not to firm the soil too much or seeds may have difficulty in germinating.)

C. Make shallow furrows across the flat, 2-3 times the length of the seed (Figure 1)

FIGURE 1



JOB SHEET #1

D. Sprinkle seeds into furrows; try to space seeds evenly

E. Cover seeds very slightly with soil mixture

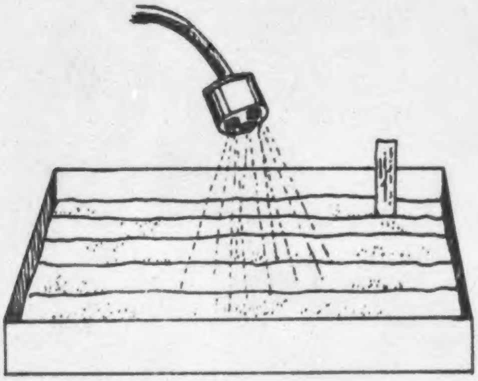
(NOTE: Do not cover seeds the size of petunias or smaller.)

F. Gently firm soil in over seeds

G. Water seeds in thoroughly using watering bulb or mist nozzle (Figure 2)

(NOTE: The flat may be soaked from the bottom in warm water.)

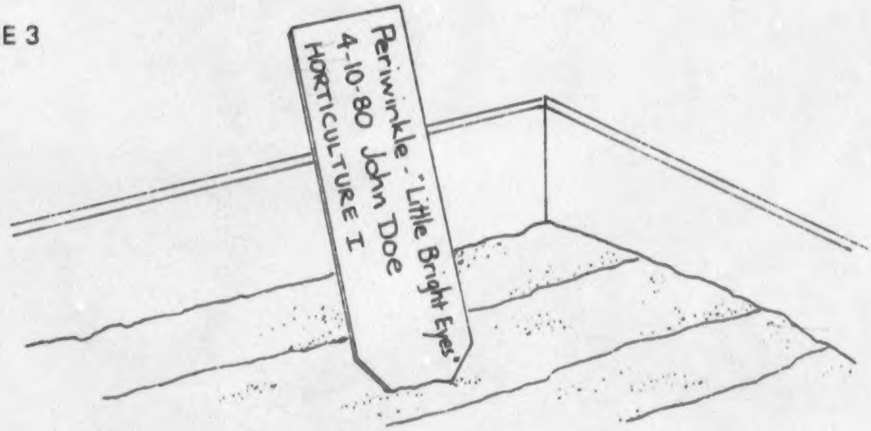
FIGURE 2



H. Identify the flat properly with identification stake (See Figure 3 for example)

(NOTE: Germination may be enhanced by covering the flat with plastic; the plastic should be removed when seedlings first become visible.)

FIGURE 3



I. Place stake in flat

SEXUAL PLANT PROPAGATION
UNIT I

JOB SHEET #2--SCARIFY SEEDS BY FILE OR SANDPAPER METHOD

I. Materials

A. Seeds with hard coat

Examples: Redbud, peach, mimosa

B. Three-sided file or sandpaper

II. Procedure

A. File a small notch in the seed coat or roughen side of seed with sandpaper (Figures 1 and 2)

(NOTE: Notch should be made near the embryo without damaging the embryo tissue.)

FIGURE 1

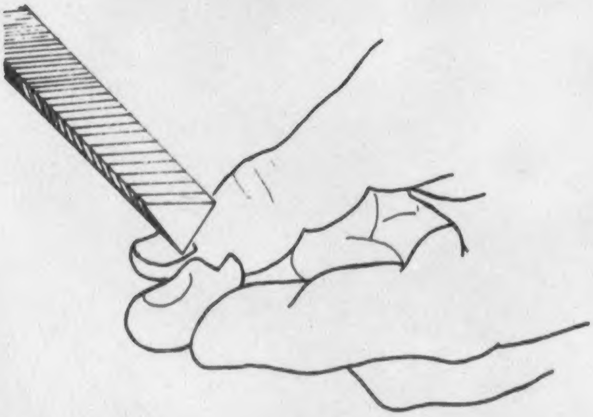
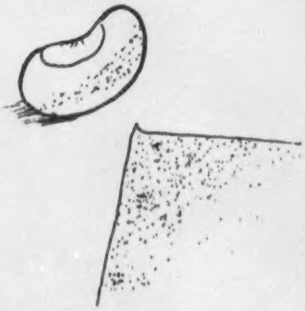


FIGURE 2



B. Plant in flat by pressing seed into soil and covering with approximately 1/4" soil mixture, or plant directly outside

SEXUAL PLANT PROPAGATION
UNIT I

JOB SHEET #3--SCARIFY SEEDS BY ACID TREATMENT

I. Materials

  A. Seeds with hard coat

  Examples: Redbud, mimosa

  B. Sulfuric acid

  C. Water

  D. Beaker

  E. Stirring rod

  F. Metal spoon

  G. Protective goggles and apron

II. Procedure

  A. Mix a dilute sulfuric acid solution of 50% acid, 50% water in beaker

  (CAUTION: Acid must be added to water; DO NOT add water to acid.)

  (NOTE: Strength varies with seed used - extremely tough seeds such as peach seeds can require full strength acid.)

  B. Stir solution thoroughly

  (CAUTION: Sulfuric acid is extremely dangerous. Avoid contact with the skin by wearing protective goggles and apron. If contact occurs, flush area with water and consult a physician.)

  C. Soak seeds in solution for 20-30 minutes

  (NOTE: Time varies with seed used.)

  D. Remove the seeds from solution using a metal spoon

  E. Rinse seeds repeatedly

  F. Plant seeds in flat by pressing seed into soil and covering approximately 1/4", or plant directly in soil

SEXUAL PLANT PROPAGATION
UNIT I

JOB SHEET #4--STRATIFY SEEDS

I. Materials

   A. 5 pecans

   B. Cooler chilled to slightly above freezing (36-38°F)

   C. Peat moss

   D. Water

   E. Plastic sandwich bag and rubber band

   (NOTE: Self-sealing bags work well and do not require tying.)

   F. China marker

   G. Plastic tag

II. Procedure

   A. Dampen peat moss with water

   B. Place peat moss in plastic bag

   C. Place pecans in bag

   D. Fasten end of bag with rubber band, or use self-sealer

   E. Fill out identification tag and attach to bag

   F. Place in cooler for 10 weeks

   Example: Refrigerator

SEXUAL PLANT PROPAGATION
UNIT I

TEST

NAME ______________________________ SCORE __________

1. Match terms associated with sexual propagation to their definitions. Write the correct numbers in the blanks provided.

_____a. Seed begins to grow

_____b. Altering the seed coat to allow water penetration into the seed

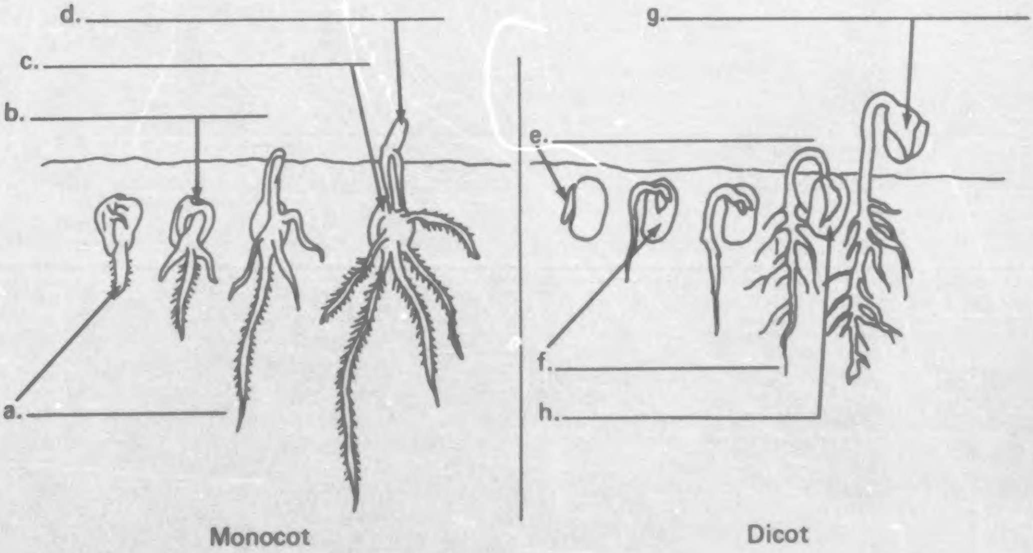
_____c. Rest period required for some seeds in order to germinate; naturally occurs in late fall and winter

_____d. Cold treatment given to some types of seeds to complete ripening and overcome dormancy

_____e. Portion of the seed which develops into a plant

1. Embryo
2. Scarification
3. Stratification
4. Dormancy
5. Germination

2. Identify parts of seedlings from the drawings below. Write the correct names in the blanks provided.



3. Name methods of seeding in the spaces below.

_____________ a. Used for small to medium-sized seeds; seeds are distributed evenly in the furrow and transplanted at a later time

_____________ b. Used for larger seeds; may be used for bedding plants to avoid transplanting later

4. State the reasons for scarification.

a. ____

b. ____

c. ____

5. Describe scarification methods in the blanks below.

a. Acid treatment-- ____

____

____

b. File or sandpaper method-- ____

____

____

c. Soak method-- ____

____

____

6. State the reason for stratification.

____

____

____

7. Demonstrate the ability to:

a. Seed a flat with fine seeds.

b. Scarify seeds by file or sandpaper method.

c. Scarify seeds by acid treatment.

d. Stratify seeds.

(NOTE: If the above activities have not been finished before the test, ask your instructor when they should be completed.)

SEXUAL PLANT PROPAGATION
UNIT I

ANSWERS TO TEST

1. a. 5
   b. 2
   c. 4
   d. 3
   e. 1
2. a. Radicle
   b. Seed coat
   c. Cotyledon
   d. Plumule
   e. Radicle
   f. Cotyledon
   g. Plumule
   h. Seed coat
3. a. Furrow method
   b. Individual seed method
4. a. Breaks the tough seed coat
   b. Aids germination
   c. Increases water absorption
5. a. Acid treatment--Seeds are placed in sulfuric acid solution for certain length of time to help soften the seed coat
   b. File or sandpaper method--Seed coat is notched by filing a small indentation
   c. Soak method--Seeds are soaked overnight in water
6. Stratification hastens germination by placing seeds in a cold, moist environment to break dormancy
7. Performance skills evaluated to satisfaction of instructor

ASEXUAL PLANT PROPAGATION
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to demonstrate the ability to propagate plants asexually by various methods. This knowledge will be evidenced by completion of job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with asexual propagation to the correct definitions.
2. Select from a list reasons for asexual propagation.
3. List factors affecting asexual propagation.
4. Match terms associated with types of asexual propagation to their descriptions.
5. List the four types of stem cuttings.
6. Label types of layerage.
7. Match different types of budding methods to the correct definitions.
8. Match types of grafts to the correct definitions.
9. Demonstrate the ability to:
    a. Propagate herbaceous stem cuttings.
    b. Propagate a leaf cutting.
    c. Air layer plants.
    d. Propagate hardwood cuttings.
    e. Bud by T-bud method.
    f. Bud by patch method.
    g. Graft by whip and tongue method.
    h. Graft by bark graft method.

ASEXUAL PLANT PROPAGATION
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Take a field trip to nurseries that use different methods of budding and grafting.

   G. Make a propagation chamber for starting cuttings.

   H. Take a field trip to a large greenhouse operation to see asexual propagation methods on a big scale.

   I. Give test.

   J. Reteach if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Job sheets

      1. Job Sheet #1--Propagate Herbaceous Stem Cuttings

      2. Job Sheet #2--Propagate a Leaf Cutting

      3. Job Sheet #3--Air Layer Plants

      4. Job Sheet #4--Propagate Hardwood Cuttings

      5. Job Sheet #5--Bud by T-bud Method

      6. Job Sheet #6--Bud by Patch Method

      7. Job Sheet #7--Graft by Whip and Tongue Method

      8. Job Sheet #8--Graft by Bark Graft Method

D. Test

E. Answers to test

III. Unit references:

A. Denison, Ervin L. *Principles of Horticulture.* New York: The Macmillan Co., 1967.

B. Hartmann, Hudson T, and Kester, Dale E. *Plant Propagation, Principles and Practices.* Englewood Cliffs: Prentice-Hall, Inc., 1975.

C. Richardson, William B., and Moore, Gary E. *Working in Horticulture.* New York: Gregg Division, McGraw-Hill Book Company, 1980.

D. *Nursery Operations. Unit Guide 5-Propagation.* Tallahassee: State of Florida Department of Education, 1977.

E. Baudendistel, Robert J. *Horticulture: A Basic Awareness.* Reston: Reston Publishing Company, 1978.

ASEXUAL PLANT PROPAGATION
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Asexual propagation--To increase plant numbers by methods other than use of seeds

   B. Grafting--Method of attaching twigs, buds or roots onto other stems or roots so that tissues are joined, and a new plant results

   C. Budding--Special type of grafting where a single bud is used as a scion

   D. Budstick-Twig used as a source of buds when budding

   E. Herbaceous--Non-woody

   F. Semi-hardwood--Current year's growth on a hardwood plant at the end of the growing season

   G. Hardwood--Plant which develops a woody stem

   H. Evergreen--Plant which retains its leaves all year

   I. Rootstock--Plant which receives a graft or bud and serves as roots for new plant

   J. Scion--Portion of the plant attached to rootstock or another twig during grafting

   K. Grafting tape--Non-stick plastic tape used to hold buds and grafts in place, and to prevent drying

   L. Budding rubbers--Narrow strips of rubber used to tie grafts and buds in place and prevent drying

   M. Grafting wax--Wax used to seal grafts

   N. Polarity--Tendency for a cutting to sprout roots from the basal end and shoots from the apex

   O. Apex--The top of a plant

II. Reasons for asexual propagation

   A. New plants are identical to parent plants

      (NOTE: Many fruit trees do not produce fruit true to cultivar.)

   B. Some plants are cheaper to propagate asexually

INFORMATION SHEET

C. Some plants are easier to propagate asexually

D. Some plants do not have seeds

E. Grafting and budding onto rootstocks can give plants the ability to resist disease or other damage

F. Larger plants can be grown faster by asexual propagation than by sexual propagation

III. Factors affecting asexual propagation

A. Time of cutting

(NOTE: Different types of cuttings are taken at different times of year for best rooting results.)

B. Health of plant

(NOTE: The cutting should have enough food to last until roots have formed.)

C. Age of cutting

(NOTE: Cuttings generally should be taken from new growth for best rooting results.)

D. Position of cutting

(NOTE: Cutting should be taken just below a node since roots form at the node where hormones accumulate.)

E. Sterility of soil

F. Moisture

(NOTE: It must be adequate to prevent drying.)

G. Proper equipment

H. Temperature

I. Light

J. Bottom heat

K. Humidity

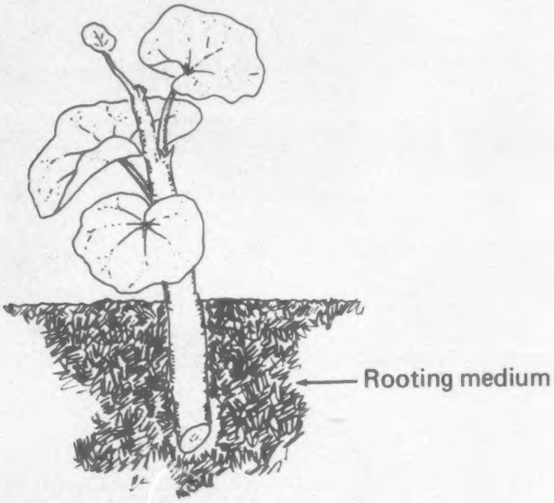
L. Media

INFORMATION SHEET

IV. Types of asexual propagation

A. Stem cuttings--Most common method of asexual propagation for houseplants; should include at least 3 nodes per cutting; tip cuttings are preferred over stems which have been cut before, to prevent a branched plant

Examples: Coleus, swedish ivy

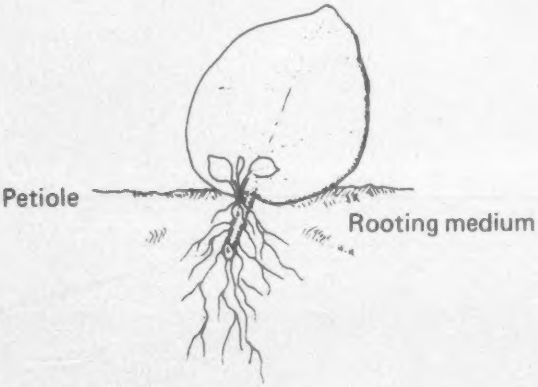


Stem Cutting

Baudendistel, *HORTICULTURE: A Basic Awareness,* 1978, p. 50. Reprinted with permission of Reston Publishing Co., a Prentice-Hall Co., 11480 Sunset Hills Road, Reston, VA 22090.

B. Leaf cuttings--Include leaf and petiole; plantlet grows from base of petiole

Examples: African violet, begonia



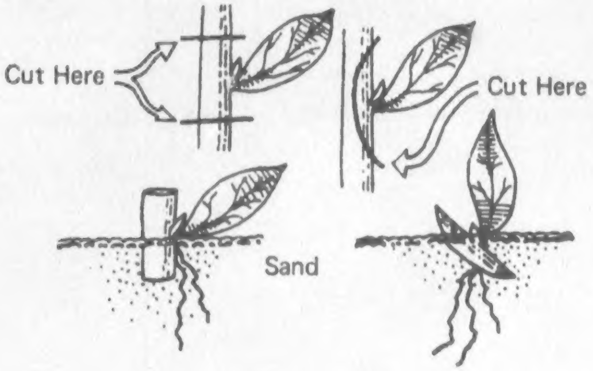
Leaf Cutting

Baudendistel, *HORTICULTURE: A Basic Awareness,* 1978, p. 52. Reprinted with permission of Reston Publishing Co., a Prentice-Hall Co., 11480 Sunset Hills Road, Reston, VA 22090.

INFORMATION SHEET

C. Leaf-bud cuttings--Must include a bud at a node for a plant to develop

Example: Jade leaves will root but plantlet will not develop unless a bud is included with the leaf



Leaf-Bud Cuttings

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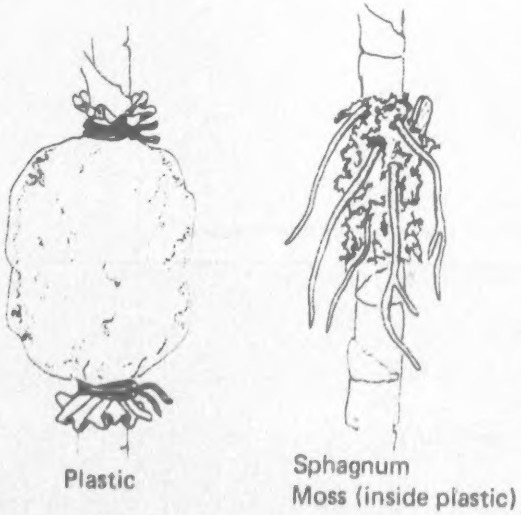
D. Root cuttings--Roots are bundled and stored at 40°F for 3 weeks; cuttings are planted 2-3 inches apart in final location

Examples: Oriental poppy, lilac, white poplar, flowering crabapples, blackberry

E. Layerage--Plants are rooted while still attached to parent plant

Examples: Rubber tree, blackberry, dieffenbachia

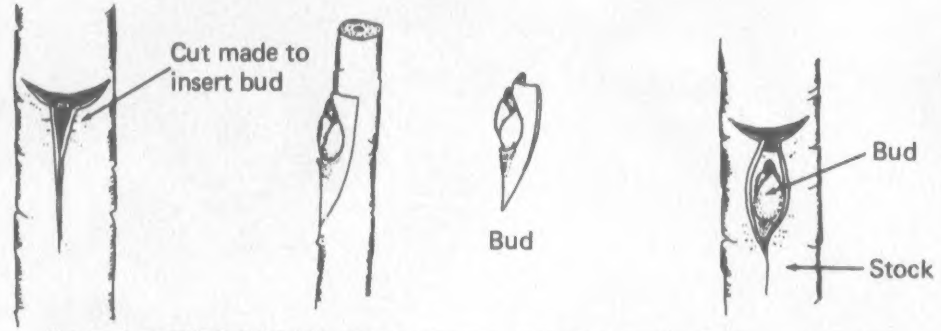


Baudendistel, *HORTICULTURE: A Basic Awareness,* 1978, p. 54. Reprinted with permission of Reston Publishing Co., a Prentice-Hall Co., 11480 Sunset Hills Road, Reston, VA 22090.

INFORMATION SHEET

F. Budding--Bud is attached to stock plant by various means to produce a more desirable plant

Examples: Pecan, peach, walnut

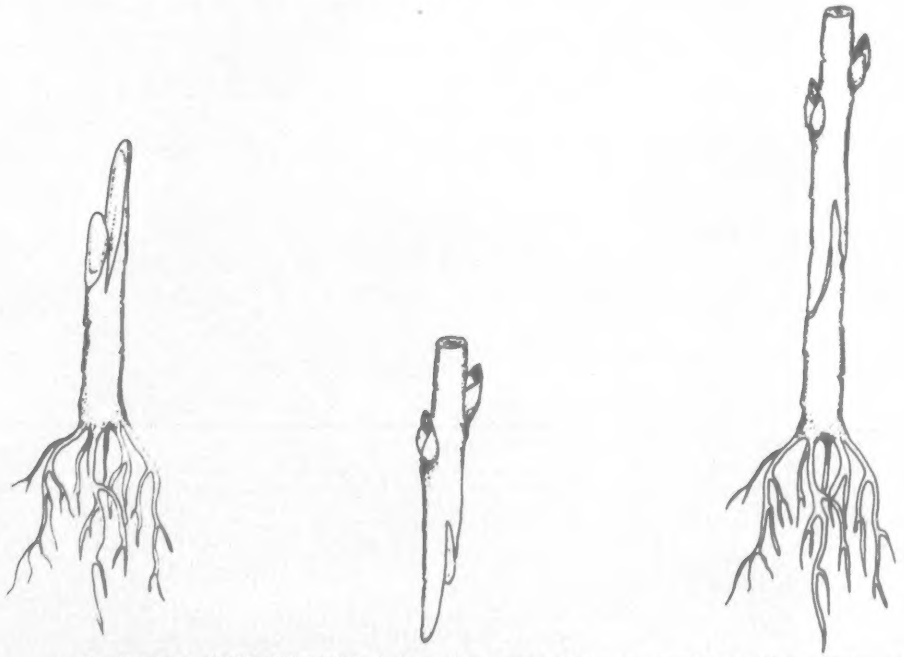


Baudendistel, *HORTICULTURE: A Basic Awareness,* 1978, p. 57. Reprinted with permission of Reston Publishing Co., a Prentice-Hall Co., 11480 Sunset Hills Road, Reston, VA 22090.

G. Grafting--Scion is attached to stock plant by various means to produce a more desirable plant

Examples: Pecan, walnut, apple, peach

(NOTE: For budding and grafting, the two plants used must be closely related for the bud or graft to succeed.)



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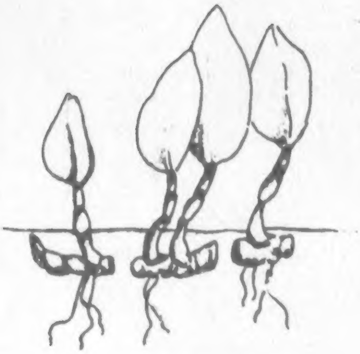
INFORMATION SHEET

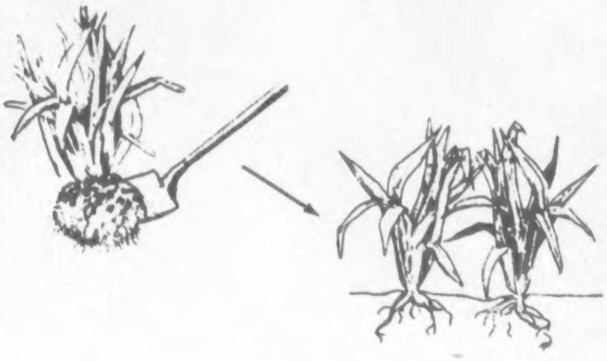
H. Division--Plants are spread by underground roots or stems

Examples: Stems--Sansevieria, iris, daylily

Roots: Liriope



Stems



Roots

Used with permission of State of Florida Department of Education from *Nursery Operations Unit Guide 5-Propagation*, copyright 1977.

I. Separation--Plants may spread by above-ground stems; bulbs form bulblets attached to side of bulb

Examples: Gladiolus and hyacinth spread by bulblets; strawberry begonia and spider plant spread by above-ground stems

V. Types of stem cuttings

A. Herbaceous

Examples: Swedish ivy, peperomia

B. Semi-hardwood

Examples: Pyracantha, azalea

C. Hardwood

Examples: Crape myrtle, honeysuckle

D. Narrowleaf evergreens

(NOTE: Cuttings are best taken in the fall or early winter.)

Examples: Junipers, pines

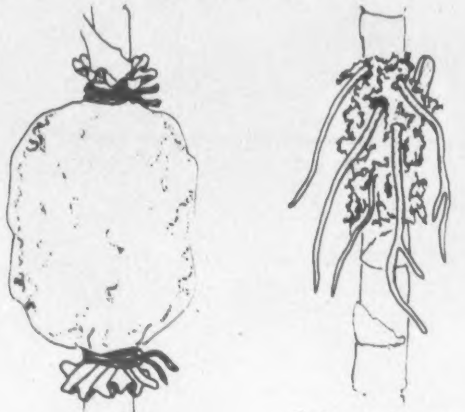
INFORMATION SHEET

VI. Types of layerage

A. Stem

(NOTE: This is also known as air layering.)

Examples: Chinese evergreen, dracaena



Plastic

Sphagnum moss (inside plastic)

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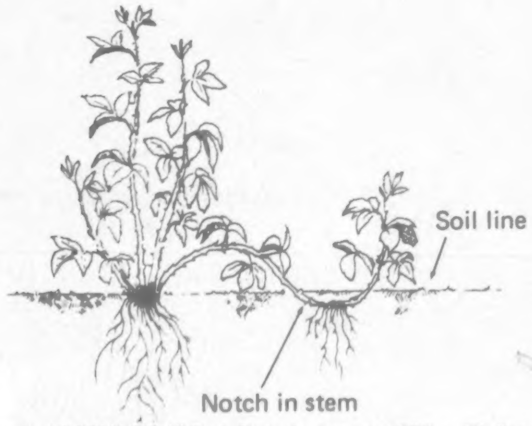
B. Tip

Examples: Azalea, blackberry



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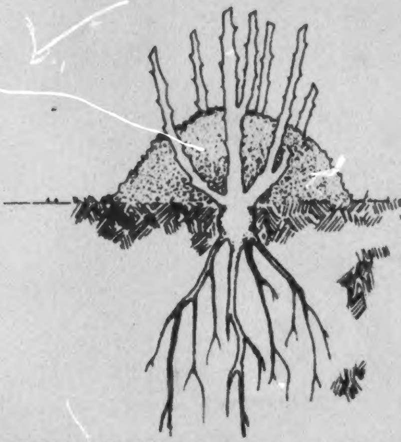
(NOTE: The tip of the stem is pulled to the ground and wounded.)

INFORMATION SHEET

C. Mound



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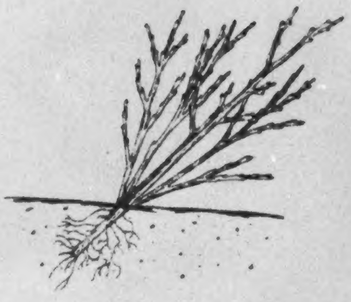
(NOTE: Soil is mounded up at the base of the plant to initiate roots.)

Examples: Roses, apples

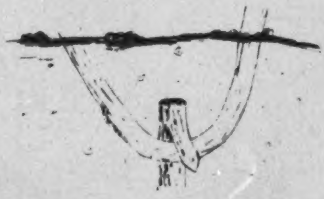
D. Trench

(NOTE: This method enables many new plants to be started at the same time. The tree is planted at a slant, to be covered by soil later.)

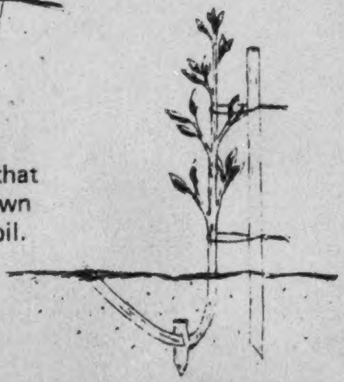
Examples: Apples, azaleas



Mother plant



Sharply bent stem that has been pegged down and covered with soil.



Stem is staked to maintain upright position.

From *The Nursery Worker Part II: Nursery Practices* by Charles E. Urbanic, rev. 1973 by Ohio Agricultural Education Curriculum Materials Service, Ohio State University.

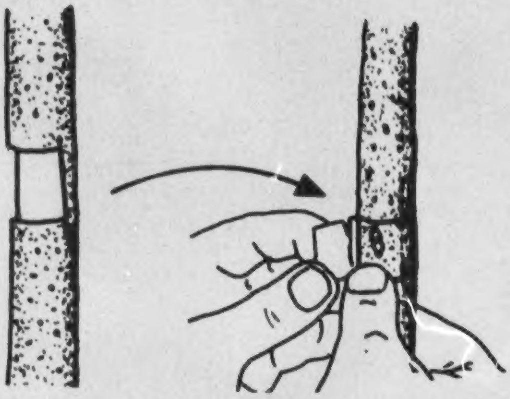
INFORMATION SHEET

VII. Budding methods

(NOTE: Trees must be actively growing at the time of budding.)

A. Patch--Transfer of bud and bark only, no wood included

(NOTE: This is one of the easiest methods; a variety of tools may be used.)

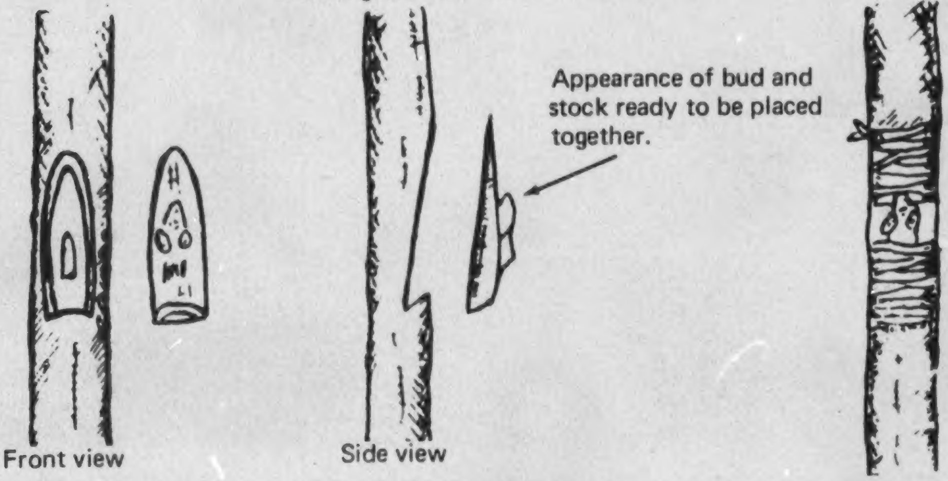


Courtesy of Oklahoma State University Cooperative Extension Service

B. Chip bud--Must include the wood behind the bud

(NOTE: With this method it is more difficult to fit size of bud to stock.)

Inserting the bud into the stock



Appearance of bud and stock ready to be placed together.

Front view

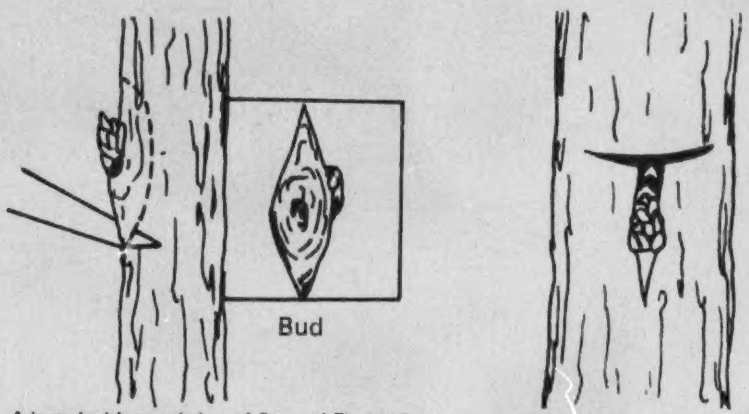
Side view

Hudson T. Hartmann, Dale E. Kester, *PLANT PROPAGATION: Principles and Practices*, 3rd ed., copyright 1975, p. 449. Reprinted by permission of Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

INFORMATION SHEET

C. T-bud--May or may not include wood behind the bud

(NOTE: If wood is removed, special care must be taken to ensure that the vascular system to the bud remains intact. This vasculature will extend slightly out the back of the bud.)



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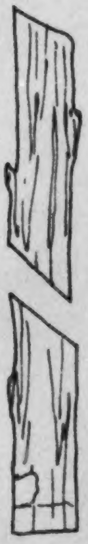
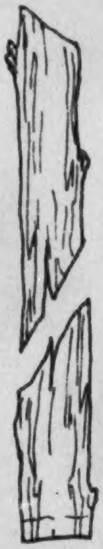
VIII. Types of grafts

A. Whip and tongue--Used for hardwood cuttings, roots, and rootstock scion grafts; fairly simple method; can be done any time

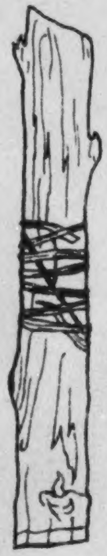
Examples: Grape, pecan, rose, orange



The sloping cuts made on the stock and scion.



The tongues cut and opened out.

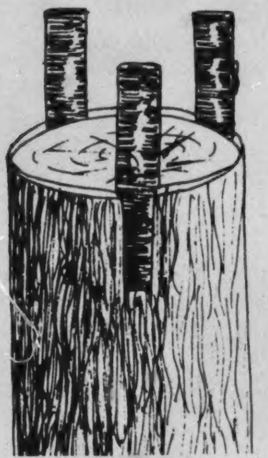


The graft completed and ready for callusing.

INFORMATION SHEET

B. Bark--Extremely easy method; must be done when bark is slipping on the stock; scion must be dormant

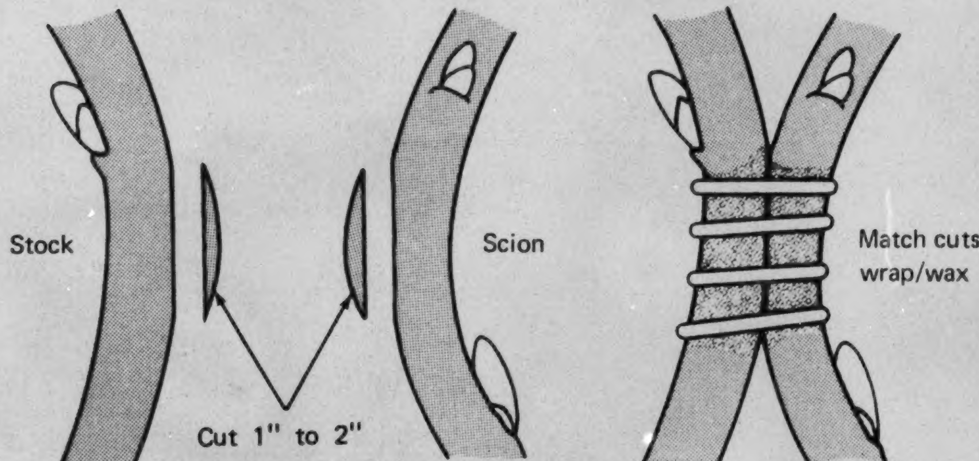
(NOTE: The bark is slipping when the cambium is actively growing and can be pulled back easily.)



From *The Nursery Worker Part II: Nursery Practices* by Charles E. Urbanic. rev. 1973 by Ohio Agricultural Education Curriculum Materials Service, Ohio State University.

C. Approach--Can be done on herbaceous and woody materials; wound area is susceptible to disease and insect problems due to V shape; used to propagate plants that are difficult to root or which do not have viable seed

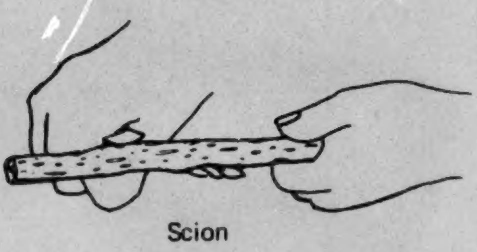
Approach grafting

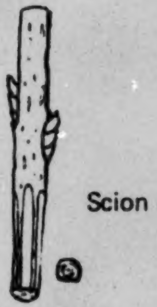


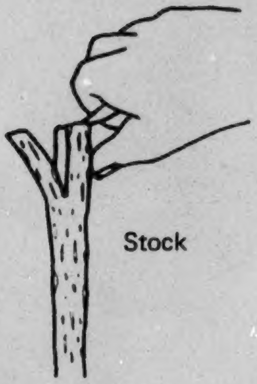
From *Working in Horticulture* by William B. Richardson and Gary E. Moore. Copyright 1980 by McGraw-Hill Book Company. Reproduced with permission.

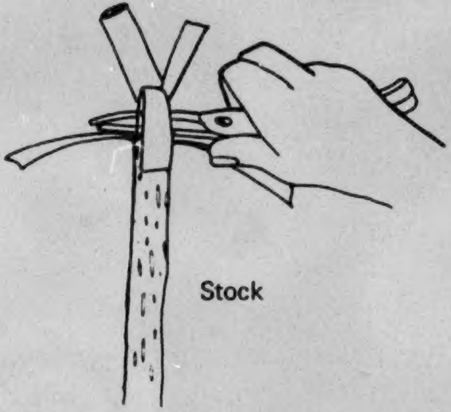
INFORMATION SHEET

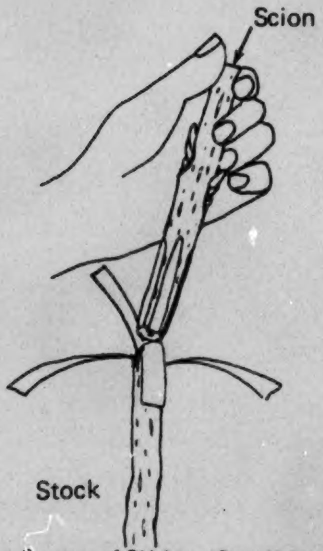
D. Four-flap (banana)--Very easy method; used any time the plant is active; comprised of 4 vertical cuts on the stock

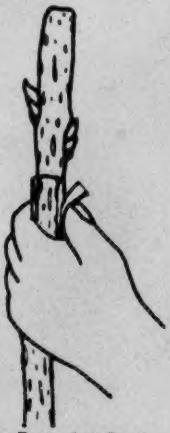


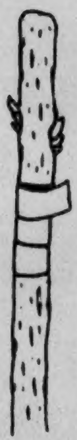







Scion
Stock





Courtesy of Oklahoma State University Cooperative Extension Service

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #1--PROPAGATE HERBACEOUS STEM CUTTINGS

I. Materials and equipment

A. Plant material

Examples: Poinsettia, chrysanthemum, coleus, kalanchoe, many other houseplants

B. Sharp knife

C. Plastic label

D. 6-cell pack or containers

E. Rooting hormone

F. Media--Can use one part peat to one part perlite, or any loose media

G. China marker

H. Mist area

II. Procedure

A. Place media in 6-cell pack or container

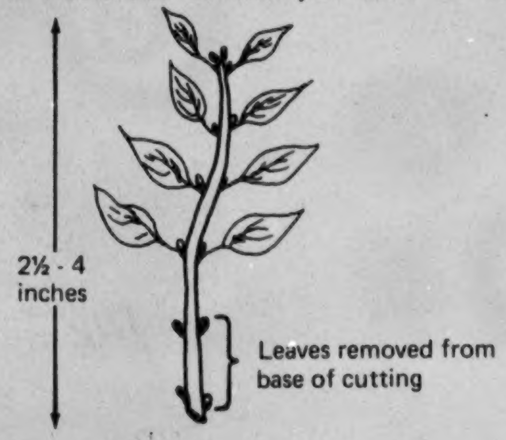
B. Select areas for cutting

(NOTE: Most cuttings should be tip cuttings. This prevents the cutting from being branched.)

C. Make cutting with sharp, clean knife at an angle

(NOTE: The cutting should be at least 2 1/2"-4" tall, and include at least three nodes. It should also be taken just below the node. See Figure 1)

FIGURE 1



JOB SHEET #1

D. Remove lower leaves (See Figure 1)

E. Dip stem end in tray with powdered rooting hormone

(NOTE: Once hormone has been poured out, do not pour back into container in order to avoid contamination.)

F. Place cutting in one cell of the pack or in container

G. Slightly firm into place

H. Repeat procedure to fill all 6 cells or containers

I. Label plastic tag and place in soil

J. Water very carefully

K. Place under mist

(NOTE: If mist area is not available, make a frame covered with plastic to keep plants in humid area.)

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #2--PROPAGATE A LEAF CUTTING

I. Materials and equipment

- A. Plant material

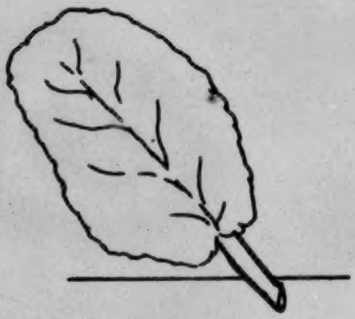
  Examples: African violet, rex begonia

- B. Sharp knife
- C. Rooting hormone
- D. 6-cell pack or container
- E. Label
- F. China marker
- G. Mist area
- H. Media

II. Procedure

- A. Select healthy leaves for cuttings
- B. Place soil in pack
- C. Make a slanted cut at the base of the petiole (Figure 1)

FIGURE 1



- D. Dip stem end into rooting hormone
- E. Place cuttings in pack or container
- F. Label pack or container
- G. Water cuttings in carefully

JOB SHEET #2

H. Place cuttings under mist

I. Transplant when cuttings are rooted--plantlets will develop from the petiole (See Figure 2)

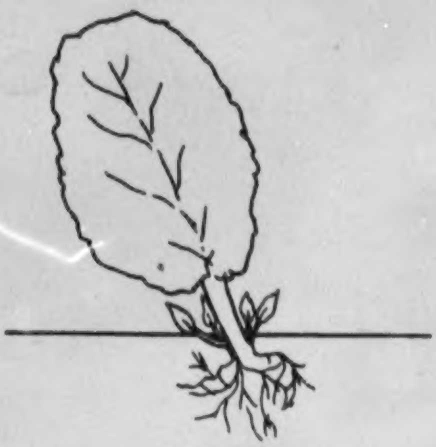


FIGURE 2

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #3--AIR LAYER PLANTS

I. Materials and equipment

A. Plant material

(NOTE: Plants with a large central stem work best.)

Examples: Dieffenbachia, chinese evergreen, dracaena, rubber tree

B. Moist peat

C. Sharp knife

D. Rooting hormone

E. Small section of toothpick

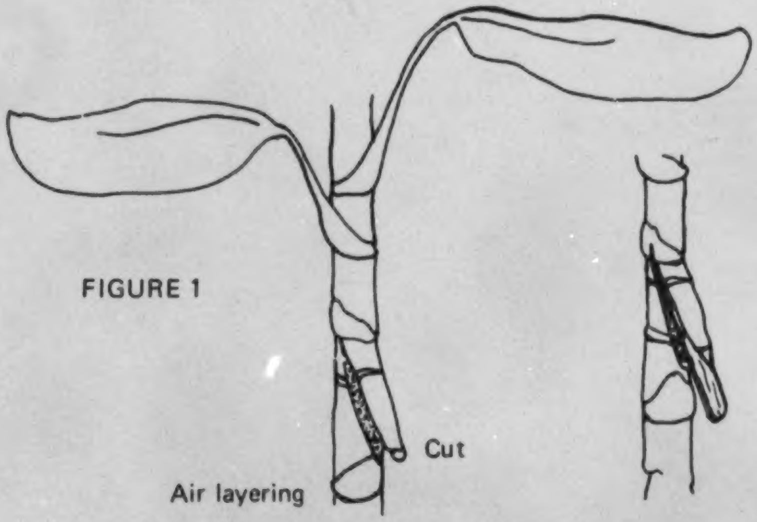
F. Air-layer poly or plastic wrap

G. String

II. Procedure

A. Make sloping cut up into stem of plant approximately 1-2" long, and 1/3 of way through stem (Figure 1)

FIGURE 1



B. Place small piece of toothpick in wound to hold open

C. Flip rooting hormone into wound

D. Place moist peat in poly

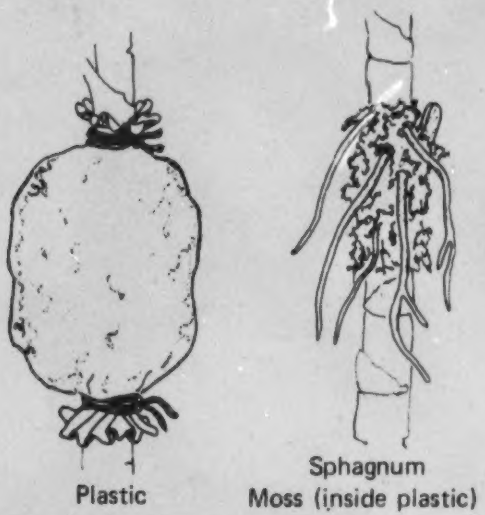
JOB SHEET #3

E. Place poly tightly around wound area

(NOTE: Budding rubbers can also be used.)

F. Tie off poly with string so that it is airtight (Figure 2)

FIGURE 2



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G. Cut off under rooted area and pot

(NOTE: Airlayering usually takes from four to six weeks for good root development.)

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #4--PROPAGATE HARDWOOD CUTTINGS

I. Materials and equipment

A. Plant material

Examples: Willow, crape myrtle, honeysuckle, wisteria, pyracantha, azalea

B. Sharp knife or shears

C. Plastic label

D. China marker

E. Soil medium

F. Container

(NOTE: This may be a 6-cell pack, flat, individual pots, or plants may be rooted in the ground.)

II. Procedure

A. Place soil in container

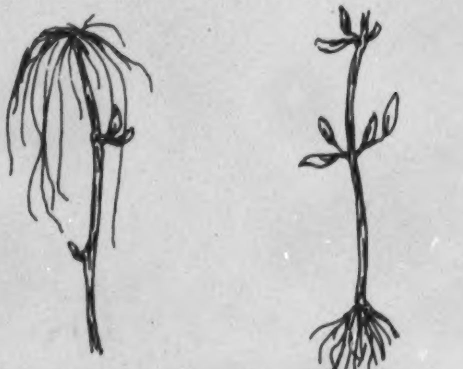
B. Select stems for cuttings

C. Make cuttings 4-12 inches in length, including at least 2 nodes

D. Place cutting in soil and firm in

(NOTE: Polarity is important. To prevent any mistakes, cut the top of the cutting flat across and the base of the cutting at a slant. See Figure 1.)

FIGURE 1



Correct Polarity Incorrect Polarity

JOB SHEET #4

E. Water cutting in carefully

F. Label cutting

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #5--BUD BY T-BUD METHOD

I. Materials and equipment

   A. Budstick--1/4"-1" in diameter

   B. Rootstock--1/4"-1" in diameter

   (NOTE: Rootstock and bud wood must be comparable plants, such as walnut and pecan, or different varieties of the same plant.)

   C. Sharp knife

   D. Plastic grafting tape or budding rubbers

   E. Tag

II. Procedure

   A. Select bud wood with bark slipping and of proper size

   B. Select rootstock with bark slipping and of proper size

   C. Make the "T" incision on the rootstock, through the bark (Figure 1)

      1. Make vertical cut 1" long

      2. Make horizontal cut 1/3 distance around stock

      (NOTE: Slightly twist the knife to open the flaps.)

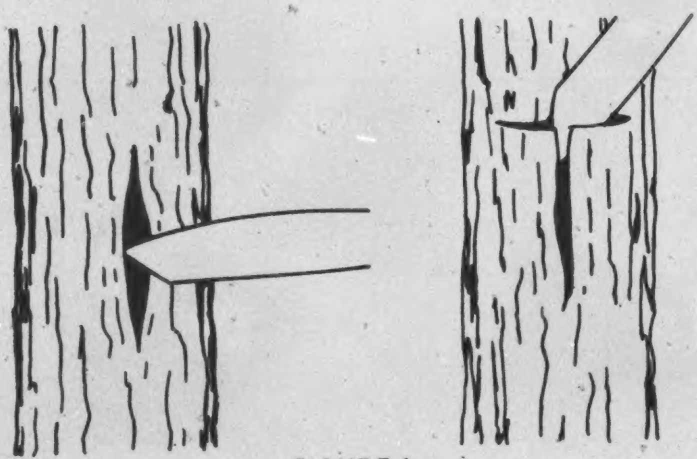


FIGURE 1

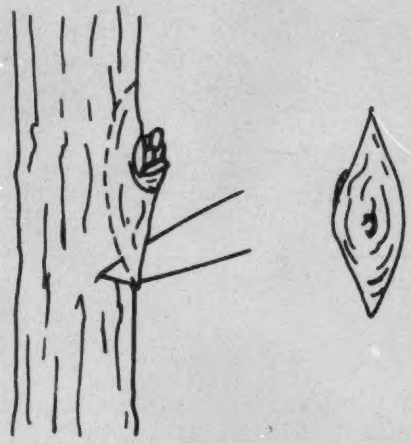
Adapted with permission of State of Florida Department of Education from *Nursery Operations Unit Guide 5-Propagation*, copyright 1977.

JOB SHEET #5

D. Prepare bud

1. Make incision beginning 1/2" below selected bud and ending 1" above bud (Figure 2)

FIGURE 2



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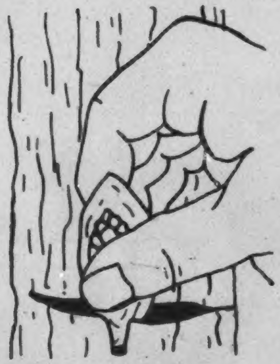
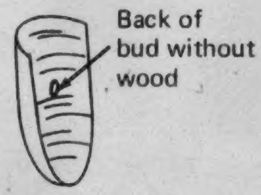
E. Place bud in the T incision by pushing bud downward under the two flaps of bark until bud is completely inserted (Figures 3 and 4)

FIGURE 3





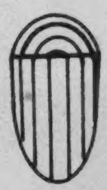
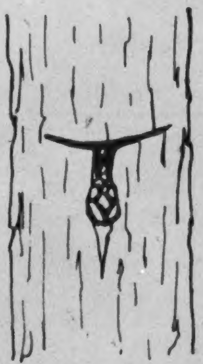


FIGURE 4



(NOTE: The piece of wood may or may not be removed from the bud piece interior. If removed, the center of the bud containing the vascular system must be intact for growth, so remove the wood very carefully.)

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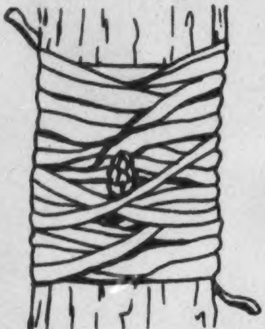
JOB SHEET #5

F. Tie bud in place with either grafting tape or budding rubbers (Figure 5)

(CAUTION: Do not cover the bud when tying into place or growth will not take place.)

FIGURE 5



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G. Label bud location

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #6--BUD BY PATCH METHOD

I. Materials and equipment

A. Rootstock--1/4"-1" in diameter

B. Budstick--1/4"-1" in diameter

C. Cutting tool

Examples: Double blade knife, single blade knife, adjustable razors, patcher tool

D. Grafting tape or budding rubbers

E. Label or tag

II. Procedure

A. Select proper rootstock

B. Select proper budstick

C. Make incisions on rootstock using single or double blade knife (Figures 1, 2, and 3)

(NOTE: Single or double bladed methods can be used.)

FIGURE 1

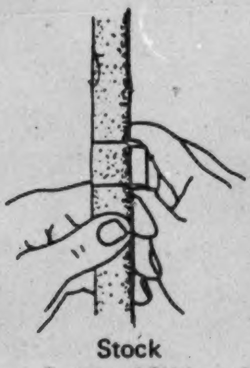


FIGURE 2

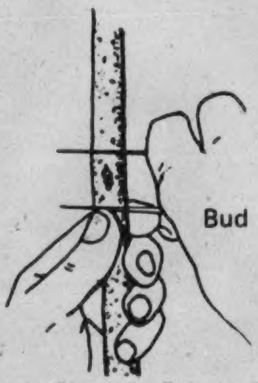
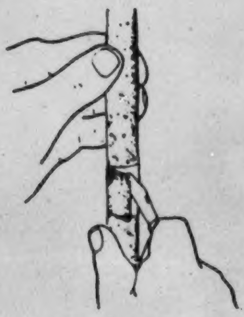


FIGURE 3



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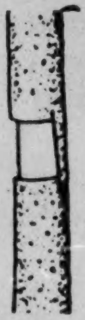
D. Make identical cuts on budstick

JOB SHEET #6

E. Transfer the bud into the stock (Figures 4 and 5)

FIGURE 4



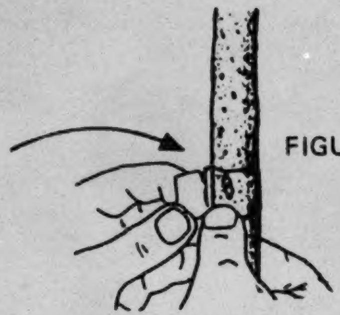
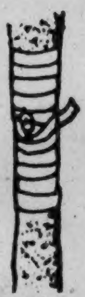


FIGURE 5

(NOTE: Do not remove bark patch from stock until ready to insert bud to prevent drying.)

F. Tie bud in place, being careful not to cover the bud (Figure 6)

FIGURE 6



Illustrations courtesy of Oklahoma State University Cooperative Extension Service

G. Label the bud location

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #7–GRAFT BY WHIP AND TONGUE METHOD

I. Materials and equipment

- A. Scion–1/4"-1/2" diameter
- B. Stock–1/4"-1/2" diameter
- C. Very sharp knife
- D. Grafting wax
- E. Grafting string
- F. Label or tag

II. Procedure

- A. Make smooth sloping cut on top end of stock–1"-2 1/2" long (Figure 1)
- B. Make smooth sloping cut on basal end of scion to match cut on stock (Figure 2)

FIGURE 1

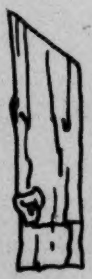
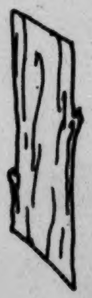
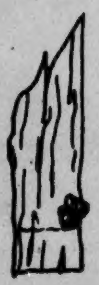


FIGURE 2



- C. Make a second cut on the stock 1/3 of distance from tip to base of first cut (Figure 3)

FIGURE 3



JOB SHEET #7

D. Make a similar cut on the scion (Figure 4)

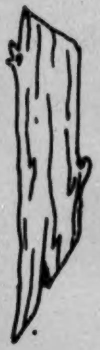


FIGURE 4

E. Slip the two cut surfaces together and interlock (Figure 5)

(NOTE: It is essential for the cambium of the two pieces to be in complete contact for growth to occur.)

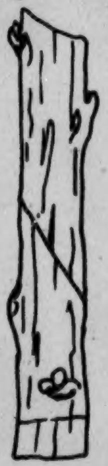


FIGURE 5

F. Tie and wax graft by coating tied area with soft grafting wax (Figure 6)

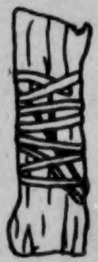


FIGURE 6

(NOTE: If graft is bedded in peat, waxing is not needed.)

Example: Grapes

G. Label graft

ASEXUAL PLANT PROPAGATION
UNIT II

JOB SHEET #8--GRAFT BY BARK GRAFT METHOD

I. Materials and equipment

A. Stock--1"to 12"

B. 2-3 scions 1/4-1/2" long with 2 or 3 buds, 4-5" long

(NOTE: Scions should be dormant; store in cooler in moist peat until needed.)

C. Sharp knife

D. Saw

E. Tinfoil

F. Flatheaded nails, 5/8"-1" long, or #19 or #20 gauge wire brads

II. Procedure

A. Saw off stock to desired graft location

B. Make two parallel, vertical cuts 1-2" long through bark

(NOTE: Width of cuts should be same as scion width.)

C. Make 1 or 2 more cuts, depending on size of the stock

D. Remove most of the bark flap (Figure 1)

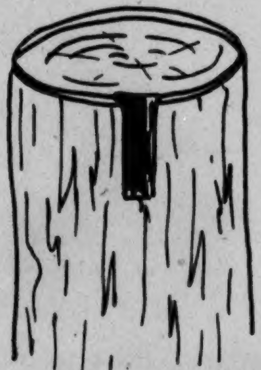


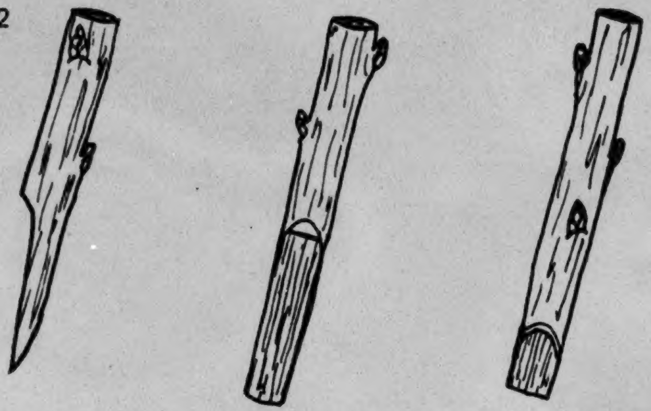
FIGURE 1

JOB SHEET #8

E. Prepare scion

1. Make a long, sloping cut on basal end of scion (Figure 2)
2. Make shorter cut on opposite side (Figure 2)

FIGURE 2



Side View Back View Front View

From *The Nursery Worker Part II: Nursery Practices* by Charles E. Urbanic. rev. 1973 by Ohio Agricultural Education Curriculum Materials Service, Ohio State University.

F. Insert scion into stock (Figure 3)

1. Slide end of scion under flap portion
2. Nail scion into place with flatheaded nails or brads

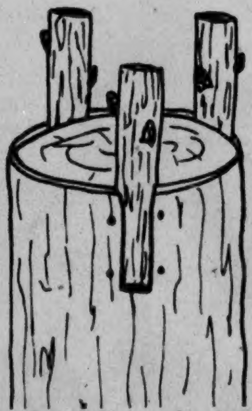


FIGURE 3

From *The Nursery Worker Part II: Nursery Practices* by Charles E. Urbanic. rev. 1973 by Ohio Agricultural Education Curriculum Materials Service, Ohio State University.

G. Repeat above procedure for additional scions

H. Cover stub with tinfoil, leaving tops of scions exposed

ASEXUAL PLANT PROPAGATION
UNIT II

TEST

NAME ________________________ SCORE ______________

1. Match terms associated with asexual propagation to the correct definitions. Write the correct numbers in the blanks provided.

_____a. To increase plant numbers by methods other than use of seeds

_____b. Portion of the plant attached to rootstock or another twig during grafting

_____c. Method of attaching twigs, buds or roots onto other stems or roots so that tissues are joined, and a new plant results

_____d. Plant which receives a graft or bud and serves as roots for new plant

_____e. Special type of grafting where a single bud is used as a scion

_____f. Plant which retains its leaves all year

_____g. Twig used as a source of buds when budding

_____h. Plant which develops a woody stem

_____i. Narrow strips of rubber used to tie grafts and buds in place and prevent drying

_____j. Non-woody

_____k. Non-stick plastic tape used to hold buds and grafts in place, and to prevent drying

_____l. Current year's growth on a hardwood plant at the end of the growing season

_____m. Wax used to seal grafts

_____n. Tendency for a cutting to sprout roots from the basal end and shoots from the apex

_____o. The top of a plant

1. Budding rubbers
2. Hardwood
3. Herbaceous
4. Scion
5. Grafting
6. Budstick
7. Evergreen
8. Grafting tape
9. Grafting wax
10. Semi-hardwood
11. Budding
12. Apex
13. Rootstock
14. Polarity
15. Asexual propagation

2. Select from the following list reasons for asexual propagation. Mark each correct answer with an "X."

_____a. New plants will be different from the parent plant

_____b. Plants are usually smaller and take more time to grow than plants grown from seed

_____c. Some plants do not have seeds

_____d. All plants are easier to propagate asexually

_____e. Grafting and budding is done to achieve some interesting looking plants

_____f. Some plants are cheaper to propagate asexually

3. List five factors affecting asexual propagation.

a. ____

b. ____

c. ____

d. ____

e. ____

4. Match terms associated with types of asexual propagation to their descriptions. Write the correct numbers in the blanks provided. Terms continue on the next page.

_____a. Most common method of asexual propagation for houseplants; should include at least 3 nodes per cutting; tip cuttings are preferred over stems which have been cut before, to prevent a branched plant

_____b. Include leaf and petiole; plantlet grows from base of petiole

_____c. Must include a bud at a node for a plant to develop

_____d. Plants are rooted while still attached to parent plant

_____e. Plants are spread by underground roots or stems

_____f. Roots are bundled and stored at 40°F for 3 weeks; cuttings are planted 2-3 inches apart in final location

1. Grafting
2. Separation
3. Layerage
4. Stem cuttings
5. Leaf cuttings
6. Division
7. Budding
8. Leaf-bud cuttings
9. Root cuttings

_____g. Bud is attached to stock plant by various means to produce a more desirable plant

_____h. Scion is attached to stock plant by various means to produce a more desirable plant

_____i. Plants may spread by above-ground stems; bulbs form bulblets attached to side of bulb

5. List the four types of stem cuttings.

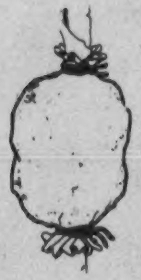
a. ____________________

b. ____________________

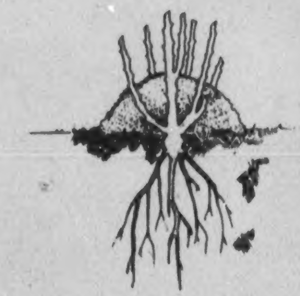
c. ____________________

d. ____________________

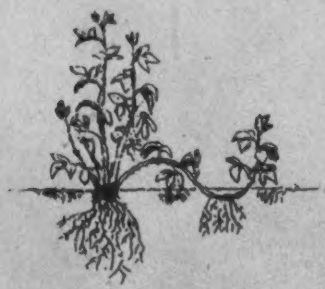
6. Label types of layerage. Write the correct names in the blanks provided.



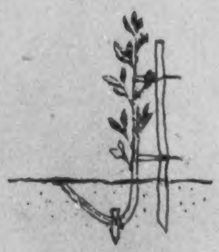
a. ____________________



b. ____________________



c. ____________________



d. ____________________

7. Match different types of budding methods to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Must include the wood behind the bud

_____b. Transfer of bud and bark only, no wood included

_____c. May or may not include wood behind the bud

1. T-bud
2. Patch
3. Chip bud

8. Match types of grafts to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Can be done on herbaceous and woody materials; wound area is susceptible to disease and insect problems due to V shape; used to propagate plants that are difficult to root or which do not have viable seed

_____b. Very easy method; used any time the plant is active; comprised of 4 vertical cuts on the stock

_____c. Used for hardwood cuttings, roots and rootstock-scion grafts; fairly simple method; can be done any time

_____d. Extremely easy method; must be done when bark is slipping on the stock; scion must be dormant

1. Four-flap (banana)
2. Bark
3. Approach
4. Whip and tongue

9. Demonstrate the ability to:

a. Propagate herbaceous stem cuttings.

b. Propagate a leaf cutting.

c. Air layer plants.

d. Propagate hardwood cuttings.

e. Bud by T-bud method.

f. Bud by patch method.

g. Graft by whip and tongue method.

h. Graft by bark graft method.

(NOTE: If the above activities have not been finished before the test, ask your instructor when they should be completed.)

ASEXUAL PLANT PROPAGATION
UNIT II

ANSWERS TO TEST

1. a. 15
   b. 4
   c. 5
   d. 13
   e. 11
   f. 7
   g. 6
   h. 2
   i. 1
   j. 3
   k. 8
   l. 10
   m. 9
   n. 14
   o. 12
2. c, f
3. Any five of the following:
   a. Time of cutting
   b. Health of plant
   c. Age of cutting
   d. Position of cutting
   e. Sterility of soil
   f. Moisture
   g. Proper equipment
   h. Temperature
   i. Light

j. Bottom heat
k. Humidity
l. Media
4. a. 4
   b. 5
   c. 8
   d. 3
   e. 6
   f. 9
   g. 7
   h. 1
   i. 2
5. a. Herbaceous
   b. Semi-hardwood
   c. Hardwood
   d. Narrowleaf evergreens
6. a. Stem layerage
   b. Mound layerage
   c. Tip layerage
   d. Trench layerage
7. a. 3
   b. 2
   c. 1
8. a. 3
   b. 1
   c. 4
   d. 2
9. Performance skills evaluated to satisfaction of instructor

ELEMENTARY STUDY OF SOILS
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to recommend treatments for soil pH problems and calculate soil types from a soil triangle. This knowledge will be evidenced by completion of the assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with soils to their definitions.
2. List the proportions of average soil composition.
3. Match soil structures to their characteristics.
4. Distinguish between types of soil particles.
5. Describe the forms of physical and chemical weathering.
6. Label a soil profile.
7. List organic and inorganic soils.
8. Match types of soil to their pH values.
9. Select from a list correct statements about the importance of pH in soil.
10. Distinguish between methods of adjusting soil pH.
11. Describe movement of water through soil.
12. Match types of soil water to their descriptions.
13. Recommend treatments for pH problems in soils.
14. Calculate soil type using a textural triangle.

ELEMENTARY STUDY OF SOILS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Make transparencies.

   B. Provide student with objective sheet.

   C. Provide student with information and assignment sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Obtain different types of soil for students to use with Assignment Sheet #1.

   G. Take a field trip to observe different appearances of soil types, textures, etc.

   H. Demonstrate how to take a soil sample.

   I. Demonstrate running a pH test.

   J. Give test.

   K. Reteach if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Composition of Average Soil

      2. TM 2--Soil Structure

      3. TM 3--Soil Particles

      4. TM 4--Soil Profile

      5. TM 5--Textural Triangle

      6. TM 6--Soil pH Values

      7. TM 7--Availability Scale

D. Assignment sheets

   1. Assignment Sheet #1--Recommend Treatments for pH Problems in Soils

   2. Assignment Sheet #2--Calculate Soil Type Using a Textural Triangle

E. Answers to assignment sheets

F. Test

G. Answers to test

III. Unit references:

A. Richardson, William B., and Moore, Gary B. *Working in Horticulture.* New York: Gregg Division/McGraw-Hill Book Company, 1980.

B. Millar, Charles E., Turk, Lloyd M., and Foth, H.D. *Fundamentals of Soil Science.* New York: John Wiley and Sons, Inc., 1978.

C. Berger, Kermit C. *Introductory Soils.* New York: The Macmillan Company, 1965.

D. Denisen, Ervin L. *Principles of Horticulture.* New York: The Macmillan Company, 1967.

E. Buckman, Harry O., and Brady, Nyle C. *The Nature and Properties of Soils.* New York: The Macmillan Company, 1967.

ELEMENTARY STUDY OF SOILS
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Organic matter--Plant and animal residues and remains

   B. Aggregate--Soil or rock formed from many smaller particles

   C. Abrasion--Wearing down of material from surfaces rubbing together

   D. pH--Measure of acidity or alkalinity of soil

   E. Leaching--Loss of nutrients from soil through water percolation

   F. Soil profile--Cross section of a soil from top to bottom

   G. Topsoil--Uppermost portion of soil; usually the most productive portion

   H. Subsoil--An intermediate soil between topsoil and parent material; originates from parent material

   I. Parent material--Original rocky material before weathering has taken place

   J. Minerals--General term for inorganic elements in soil

II. Proportions of average soil composition (Transparency 1)

   A. Organic matter--5%

   B. Water--25%

   C. Mineral matter--45%

   D. Air--25%

III. Soil structures (Transparency 2, Assignment Sheet #2)

   A. Crumb--Very porous granular structure

   B. Granular--Individual grains are grouped into aggregates with indistinct sides

   C. Platy--Aggregate has thin vertical axis and long horizontal axis; flat, tubular

   D. Prismatic--Aggregate is prism-like, with vertical axis of aggregate longer than the horizontal

INFORMATION SHEET

E. Blocky--Aggregate has equal sides; may be round (subangular) or angular

F. Columnar--Aggregate is column-like, with vertical axis longer than the horizontal

IV. Types of soil particles (Transparency 3)

A. Sand

1. Largest soil particle
2. Poor water retention
3. Poor nutrient retention
4. Drains quickly

B. Silt

1. Smaller in size than sand
2. Good water retention
3. Good nutrient retention

C. Clay

1. Smallest soil particle; microscopic
2. Very good water retention
3. Very good nutrient retention
4. May hold water and nutrients so tightly that they are unavailable for plant
5. Shrinks and expands dramatically as water varies, leaving soil cracked and cloddy

V. Forms of physical and chemical weathering

A. Physical (natural abrasion)

1. Heating and cooling
2. Freezing and thawing
3. Wind
4. Water

B. Chemical--Reactions of water, oxygen and carbon dioxide

INFORMATION SHEET

VI. Soil profile (Transparency 4)

  A. Topsoil

  B. Subsoil

  C. Parent material

VII. Organic and inorganic soils (Transparency 5)

  A. Inorganic

    1. Sandy

    2. Loam

    (NOTE: Loam is the largest soil group for agricultural use. It contains sand, silt and clay.)

    3. Clay

  B. Organic

    1. Peat

    2. Muck

VIII. pH values of soil (Transparency 6)

  A. Neutral soil--pH of 7

  B. Acidic or sour soil--pH of 7-0

  C. Alkaline or sweet soil--pH of 7-14

  (NOTE: Most horticultural crops are adapted to a pH range just below neutral, but the range varies with the crop.)

IX. Importance of pH in soil (Transparency 7)

  A. Acid soils have high or toxic concentrations of aluminum and manganese

  (NOTE: Most minerals are more soluble in acid soils.)

  B. Acid soils reduce beneficial microorganisms which decompose organic matter

  C. Alkaline soils reduce solubility of all micronutrients

  D. Alkaline soils with pH above 8.5 have high concentrations of sodium which can cause reduced growth or death of plant

INFORMATION SHEET

X. Methods of adjusting soil pH (Assignment Sheet #1)

(NOTE: Too low a pH reduces availability of aluminum and iron. Too high a pH reduces availability of nitrogen and phosphorus.)

A. Lower pH

1. Add sulfur

2. Add aluminum sulfate

B. Raise pH

1. Add agricultural lime

2. Add lime

XI. Movement of water through soil

A. Depends on texture of soil

Example: Water moves slowly through clay and quickly through sand

B. Leaches nutrients from soil which must be replenished with fertilizer

XII. Types of soil water

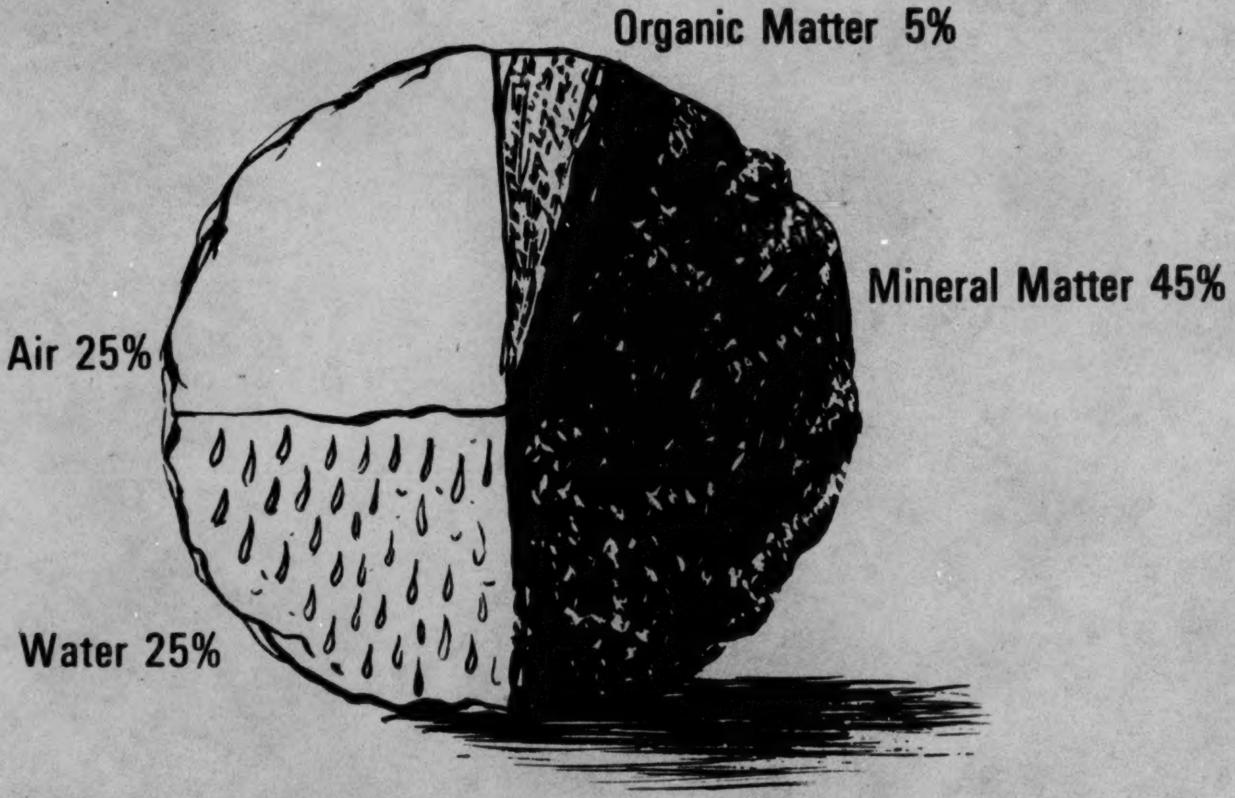
A. Gravitational--Moves through soil by gravity; not used by plant

B. Capillary--Available water held by soil

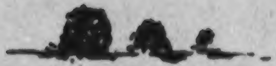
C. Hygroscopic--Water held so tightly in soil that it is unavailable to plant

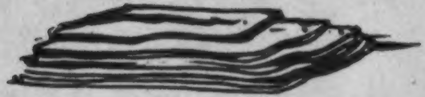
D. Field capacity--Amount of water held in soil after gravitational water has drained away

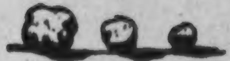
Composition of Average Soil



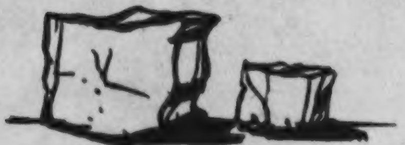
Soil Structure

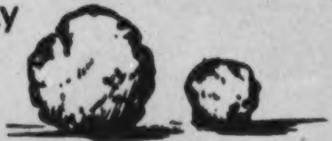

Crumb

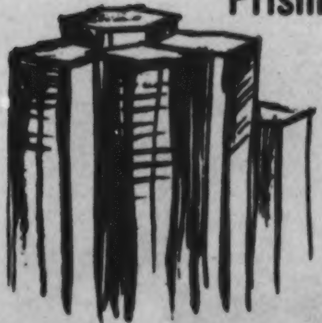

Platy

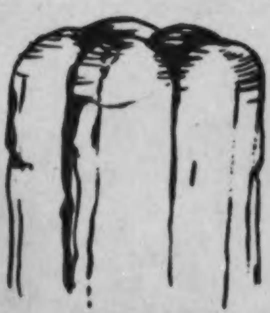

Granular

Blocky

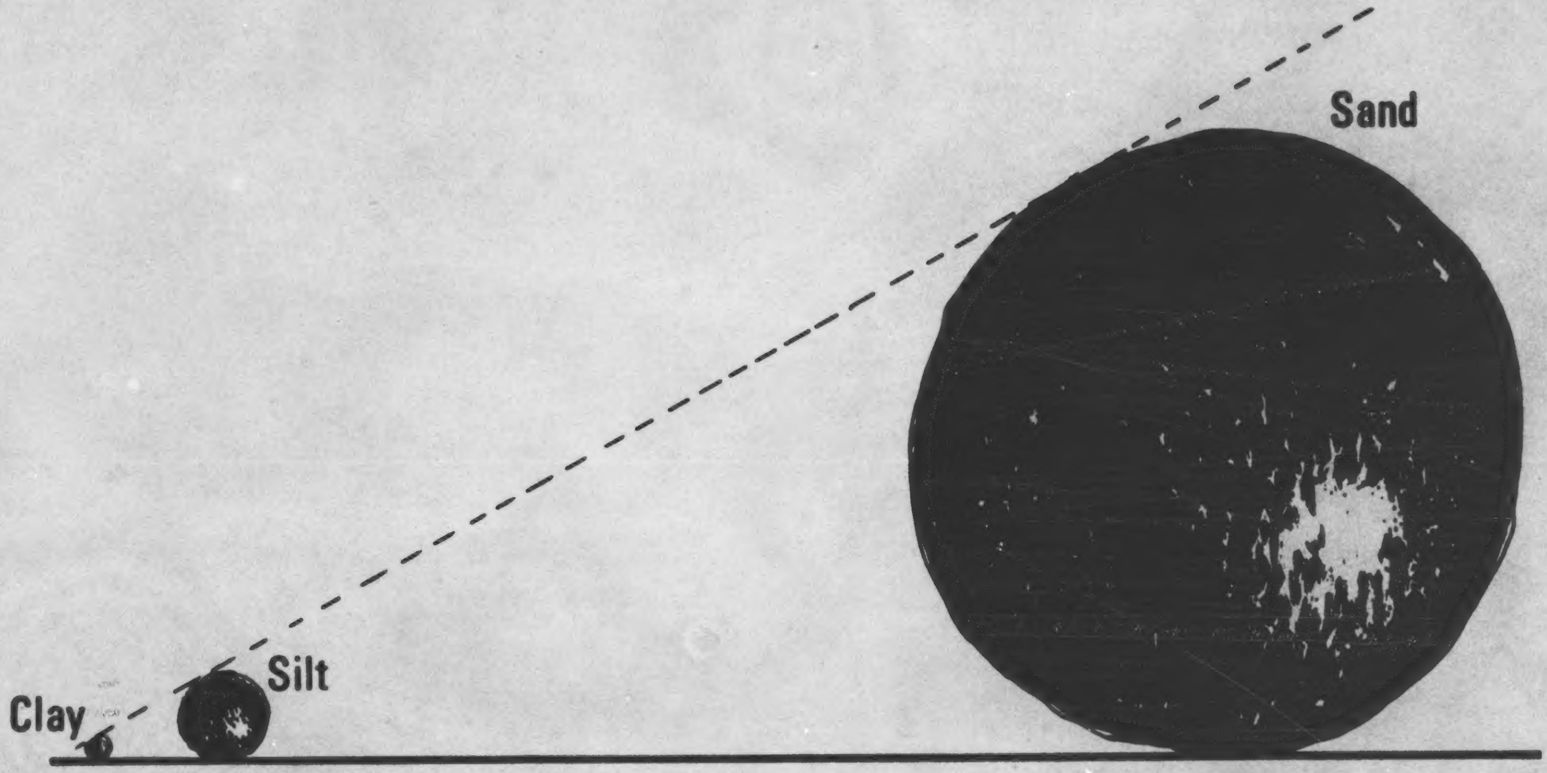

Angular Blocky


Subangular Blocky

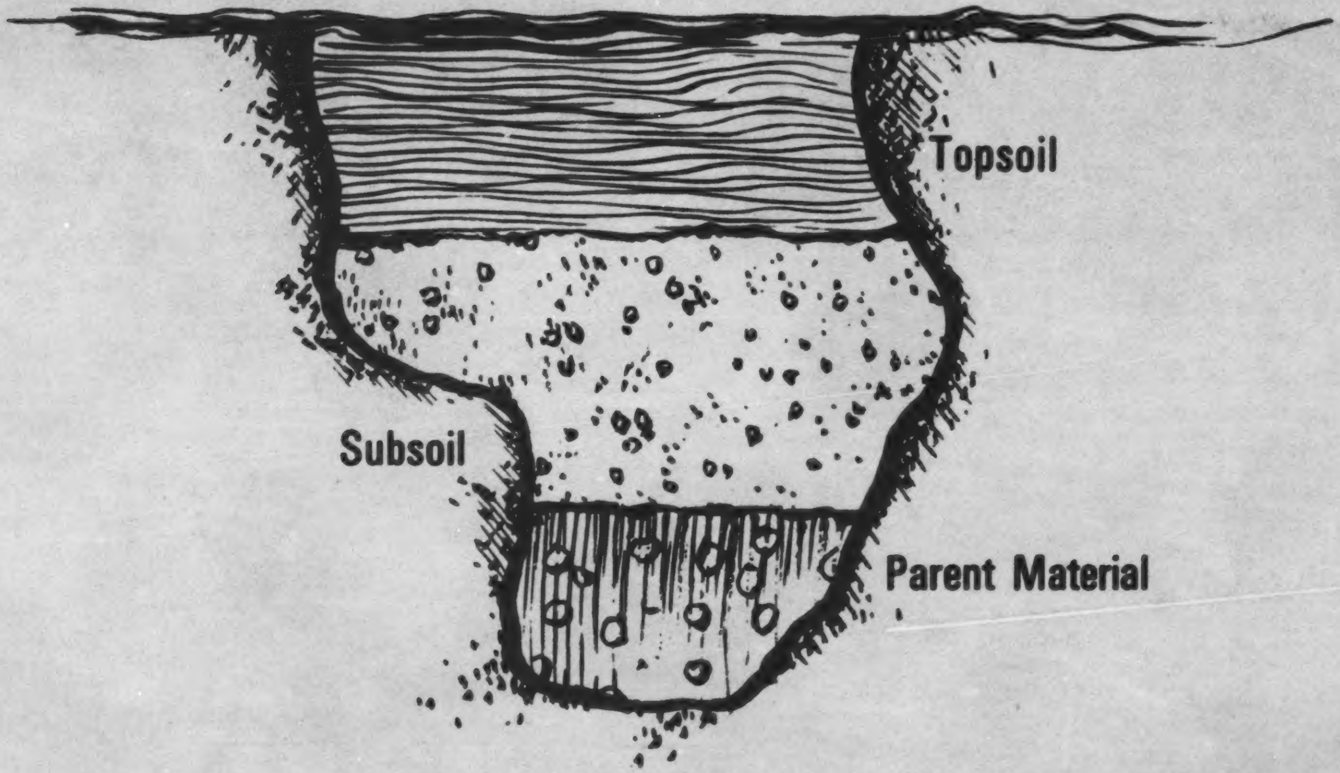
Prismatic


Columnar


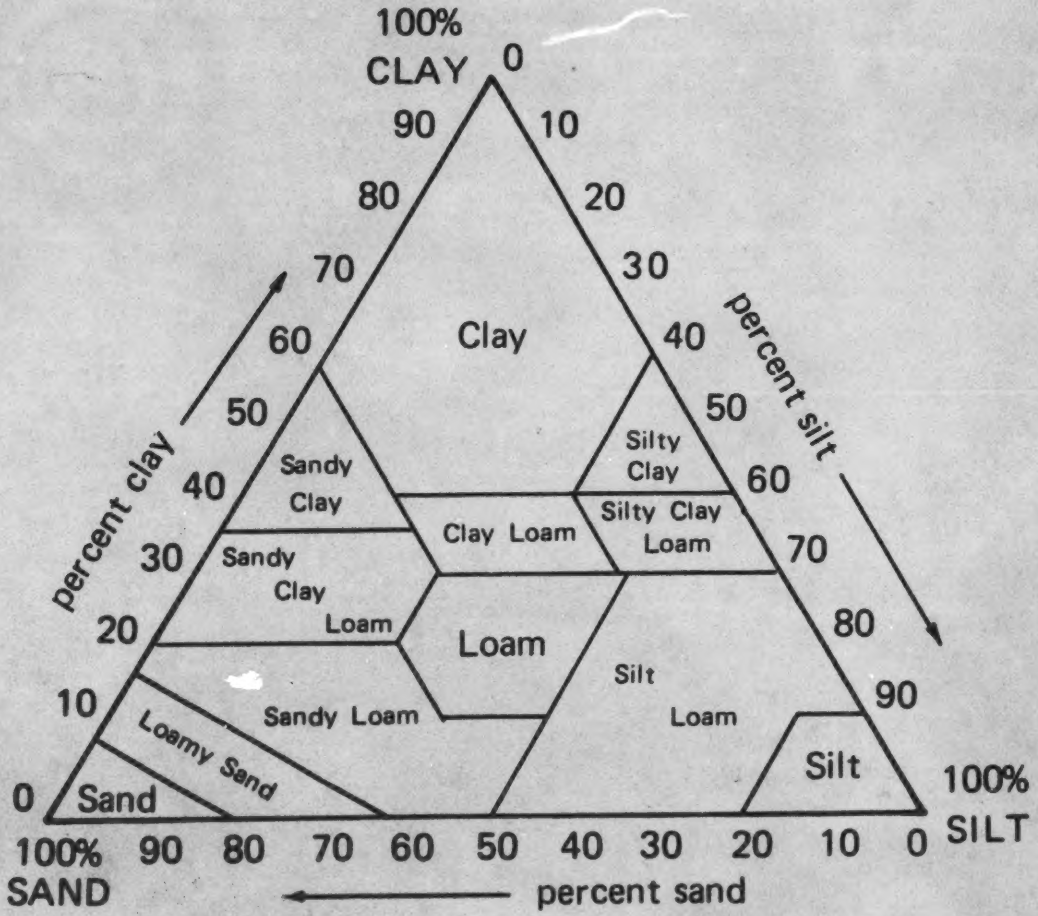
Soil Particles


Sand
Silt
Clay

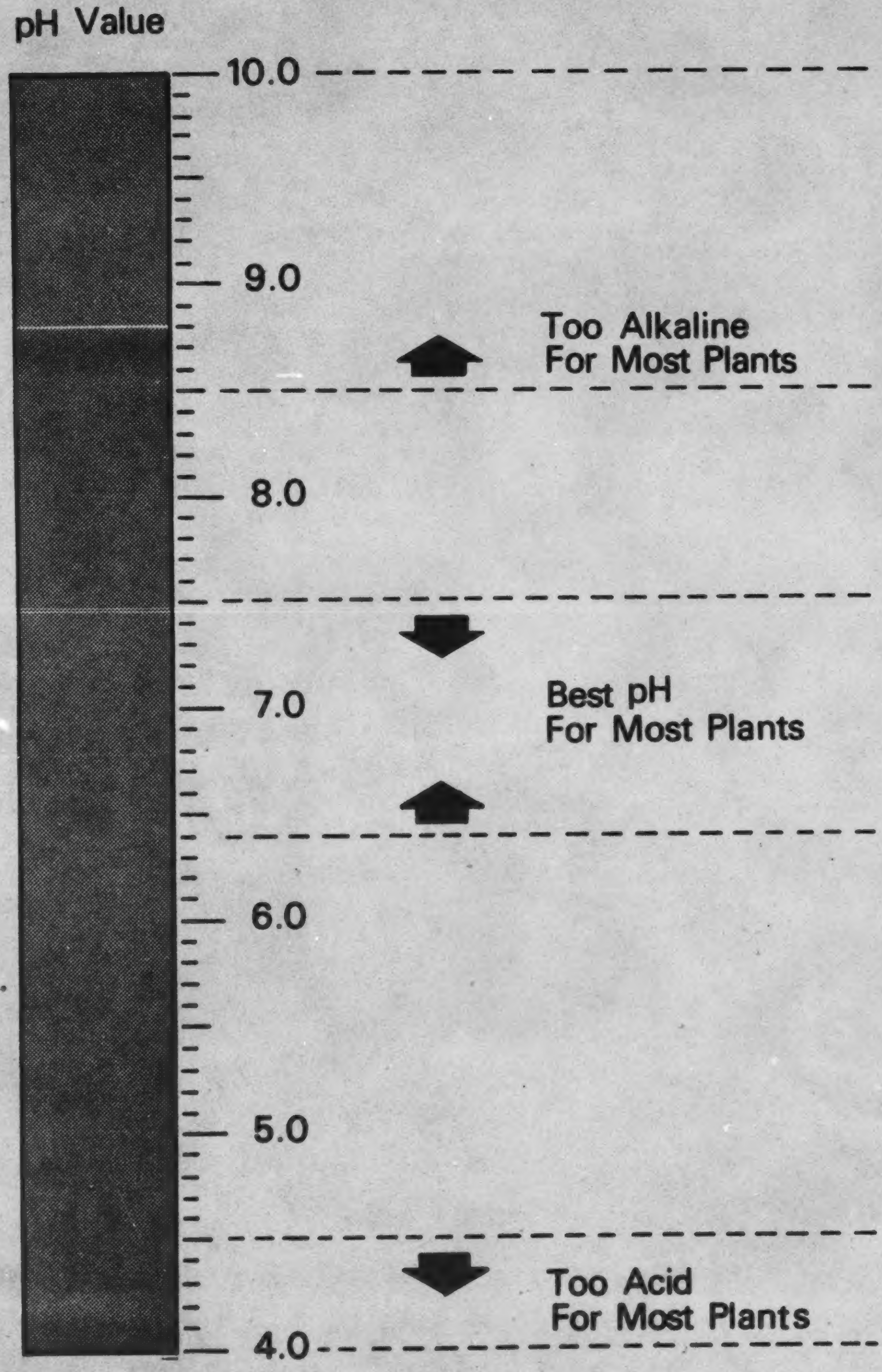
Soil Profile


Topsoil
Subsoil
Parent Material

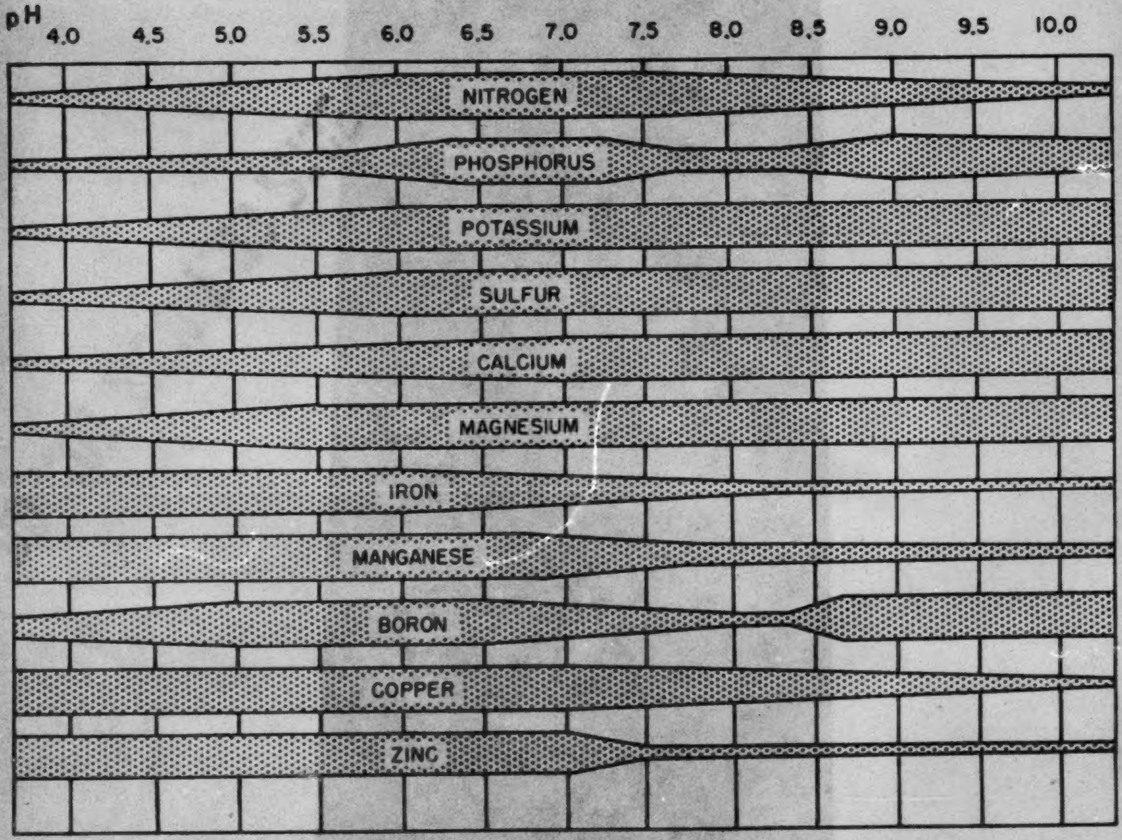
Textural Triangle


100% CLAY
0
10
20
30
40
50
60
70
80
90
100% SILT
percent silt
90
80
70
60
50
40
30
20
10
0
percent clay
100% SAND
90
80
70
60
50
40
30
20
10
0
percent sand
Clay
Sandy Clay
Silty Clay
Clay Loam
Silty Clay Loam
Sandy Clay Loam
Loam
Silt Loam
Sandy Loam
Loamy Sand
Sand
Silt

Soil pH Values



Availability Scale



ELEMENTARY STUDY OF SOILS
UNIT I

ASSIGNMENT SHEET #1--RECOMMEND TREATMENTS FOR pH PROBLEMS IN SOILS

NAME______________________________________ SCORE____________

A too-high or too-low pH value in soil can stunt or kill a plant. It is important that you know what pH values mean, and what steps to take to remedy a pH problem. Practice by answering the questions below.

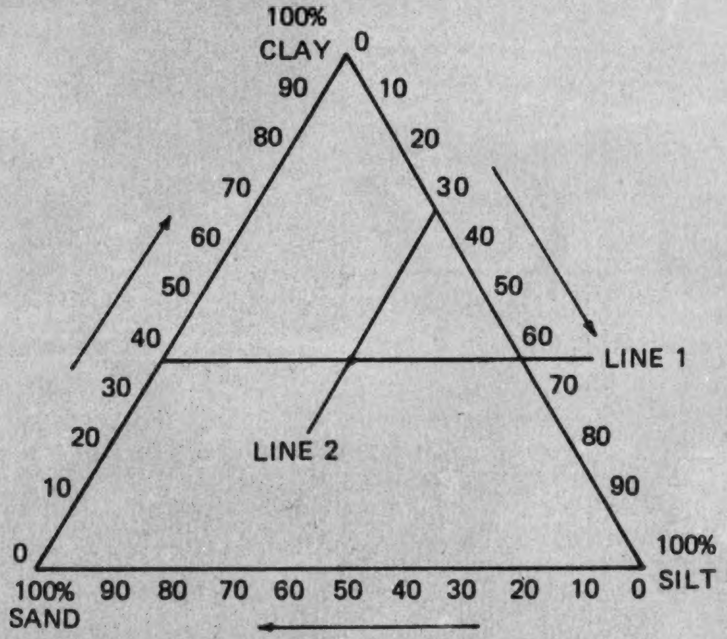
1. Your plant's soil has a pH of 8.2. A pH of 7.5 is needed. Correct the problem by adding____.
2. Your plant's soil has a pH of 4.0. A pH of 6.5 is needed. Correct the problem by adding ____.
3. Your plant's soil is too acid. Correct the problem by adding____________________.
4. Your plant's soil is too alkaline. Correct the problem by adding__________________.
5. Your plant's soil is neutral. What is the pH?______________________________.
6. Your plant's soil is sour. What is the pH range?____________to______________.
7. Your plant's soil is sweet. What is the pH range?___________to______________.

ELEMENTARY STUDY OF SOILS
UNIT I

ASSIGNMENT SHEET #2--CALCULATE SOIL TYPE USING A TEXTURAL TRIANGLE

NAME______________________________ SCORE______________

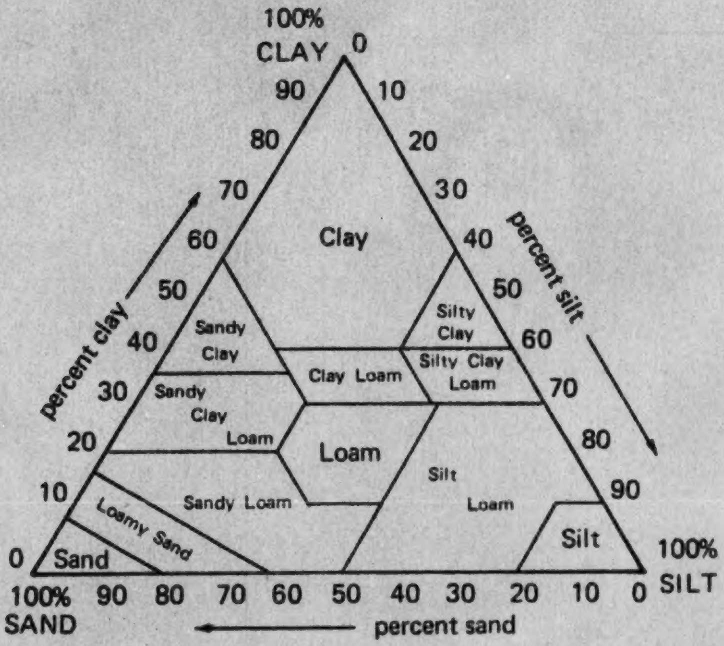
Plot soil type using the textural triangle and percentages given on the next page. Follow the step-by-step procedure and the example given below.


100% CLAY
0
10
20
30
40
50
60
70
80
90
90
80
70
60
50
40
30
20
10
0
LINE 1
LINE 2
100% SAND
90
80
70
60
50
40
30
20
10
0
100% SILT

Example: Soil type - 35% clay, 30% silt, 35% sand

1. Plot the silt and clay points on the triangle
2. Using the clay point, draw a line into the triangle parallel to the sand line (See Line 1)
3. Using the silt point, draw a line parallel to the clay line (See Line 2)
4. The point where these two lines intersect determines the soil type; in this example it is clay loam

ASSIGNMENT SHEET #2


100% CLAY
0
10
20
30
40
50
60
70
80
90
100% SILT
percent silt
percent clay
0
10
20
30
40
50
60
70
80
90
100% SAND
percent sand
Clay
Sandy Clay
Silty Clay
Sandy Clay Loam
Clay Loam
Silty Clay Loam
Loam
Silt Loam
Sandy Loam
Loamy Sand
Sand
Silt

	% Clay	% Silt	% Sand		Soil Type
1.	60	30	10	a.	______________
2.	40	10	50	b.	______________
3.	20	20	60	c.	______________
4.	50	30	20	d.	______________
5.	10	30	60	e.	______________
6.	30	45	25	f.	______________
7.	75	10	15	g.	______________
8.	30	40	30	h.	______________
9.	25	50	25	i.	______________
10.	20	35	45	j.	______________

ELEMENTARY STUDY OF SOILS
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

(NOTE: Only one answer is required per question.)

1. Sulphur, aluminum sulfate
2. Agricultural lime, lime
3. Agricultural lime, lime
4. Sulphur, aluminum sulfate
5. 7
6. 7-0
7. 7-14

Assignment Sheet #2

a. Clay
b. Sandy clay
c. Loam
d. Clay
e. Sandy loam
f. Clay loam
g. Clay
h. Clay loam
i. Silt loam
j. Loam

ELEMENTARY STUDY OF SOILS
UNIT I

TEST

NAME_____________________________________ SCORE_______________

1. Match terms associated with soils to their definitions. Write the correct numbers in the blanks provided.

_____a. General term for inorganic elements in soil

_____b. Plant and animal residues and remains

_____c. Original rocky material before weathering has taken place

_____d. Soil or rock formed from many smaller particles

_____e. Wearing down of material from surfaces rubbing together

_____f. An intermediate soil between topsoil and parent material; originates from parent material

_____g. Measure of acidity or alkalinity of soil

_____h. Loss of nutrients from soil through water percolation

_____i. Uppermost portion of soil; usually the most productive portion

_____j. Cross section of a soil from top to bottom

1. Organic matter
2. Aggregate
3. Abrasion
4. pH
5. Leaching
6. Soil profile
7. Topsoil
8. Subsoil
9. Parent material
10. Minerals

2. List the proportions of average soil composition. Write the correct percentages in the blanks provided.

a. Organic matter _____%

b. Water _____%

c. Mineral matter _____%

d. Air _____%

3. Match soil structures to their characteristics. Write the correct numbers in the blanks provided.

_____a. Aggregate is column-like, with vertical axis longer than the horizontal

_____b. Very porous granular structure

_____c. Aggregate has thin vertical axis and long horizontal axis; flat, tubular

_____d. Individual grains are grouped into aggregates with indistinct sides

_____e. Aggregate has equal sides; may be round (subangular) or angular

_____f. Aggregate is prism-like, with vertical axis of aggregate longer than the horizontal

1. Platy
2. Columnar
3. Granular
4. Crumb
5. Prismatic
6. Blocky

4. Distinguish between types of soil particles. Write the correct names in the blanks provided.

___________a. Largest soil particle; poor water retention; poor nutrient retention; drains quickly

___________b. Smallest soil particle; microscopic; very good water retention; very good nutrient retention; may hold water and nutrients so tightly that they are unavailable for plant; shrinks and expands dramatically as water varies, leaving soil cracked and cloddy

___________c. Smaller in size than sand; good water retention; good nutrient retention

5. Describe the forms of physical and chemical weathering.

a. Physical (natural abrasion)--_____________________________________

____

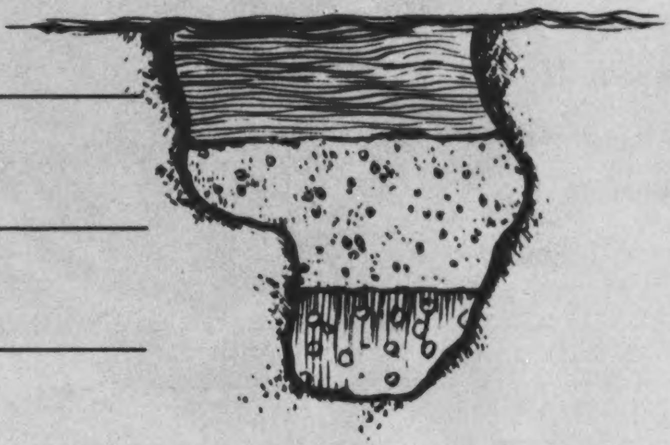
____

b. Chemical--_____________________________________

____

____

6. Label a soil profile. Write the correct names in the blanks provided.



a. ________________

b. ________________

c. ________________

7. List organic and inorganic soils in the spaces below.

A. Inorganic	B. Organic
1. ______________________	1. ______________________
2. ______________________	2. ______________________
3. ______________________	

8. Match types of soil to their pH values. Write the correct numbers in the blanks provided.

_____a. Neutral soil	1. pH of 7-0
_____b. Acidic or sour soil	2. pH of 7-14
_____c. Alkaline or sweet soil	3. pH of 7

9. Select from the list below correct statements about the importance of pH in soil. Mark each correct answer with an "X."

_____a. Acid soils have high or toxic concentrations of aluminum and manganese

_____b. Acid soils increase beneficial organism populations

_____c. Alkaline soils reduce solubility of all micronutrients

_____d. Alkaline soils with pH below 8.5 have high concentrations of sodium which can cause reduced growth or death of plant

10. Distinguish between methods of adjusting soil pH. Write an "L" for methods used to lower pH and an "R" for methods used to raise pH.

______a. Add lime

______b. Add sulfur

______c. Add aluminum sulfate

______d. Add agricultural lime

11. Describe movement of water through soil.

____

____

____

12. Match types of soil water to their descriptions. Write the correct numbers in the blanks provided.

______a. Moves through soil by gravity; not used by plant

______b. Available water held by soil

______c. Water held so tightly in soil that it is unavailable to plant

______d. Amount of water held in soil after gravitational water has drained away

1. Gravitational
2. Hygroscopic
3. Capillary
4. Field capacity

13. Recommend treatments for pH problems in soils.

14. Calculate soil type using a textural triangle.

(NOTE: If activities 13 and 14 have not been finished before the test, ask your instructor when they should be completed.)

ELEMENTARY STUDY OF SOILS
UNIT I

ANSWERS TO TEST

1. a. 10
   b. 1
   c. 9
   d. 2
   e. 3
   f. 8
   g. 4
   h. 5
   i. 7
   j. 6
2. a. 5%
   b. 25%
   c. 45%
   d. 25%
3. a. 2
   b. 4
   c. 1
   d. 3
   e. 6
   f. 5
4. a. Sand
   b. Clay
   c. Silt

5. a. Physical (natural abrasion)--Heating and cooling, freezing and thawing, wind, water

b. Chemical--Reactions of water, oxygen, and carbon dioxide

6. a. Topsoil

b. Subsoil

c. Parent material

7. a. Inorganic

1. Sandy

2. Loam

3. Clay

b. Organic

1. Peat

2. Muck

8. a. 3

b. 1

c. 2

9. a, c

10. a. R

b. L

c. L

d. R

11. Movement of water through soil depends on texture of soil; leaches nutrients from soil which must be replenished with fertilizer

12. a. 1

b. 3

c. 2

d. 4

13. Evaluated to satisfaction of instructor

14. Evaluated to satisfaction of instructor

SOIL MANAGEMENT TECHNIQUES
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to use knowledge of soil management techniques to locate good and poor soil conservation practices. The student should also be able to recommend treatments for soil management problems. This knowledge will be shown by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with soil management to the correct definitions.
2. Select from a list types of erosion.
3. Match degrees of erosion to the correct descriptions.
4. List factors involved in soil fertility depletion.
5. List types of soil depths.
6. Label degrees of slope.
7. Select from a list recommended soil conservation practices.
8. Select from a list recommended soil management practices.
9. List reasons for cultivation.
10. Locate good and poor soil conservation practices.
11. Recommend treatments for soil management problems.

SOIL MANAGEMENT TECHNIQUES
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

- A. Provide student with objective sheet.
- B. Provide student with information and assignment sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information sheet.
- F. Take a field trip to observe different soil management practices and areas needing improvement.
- G. Give test.
- H. Reteach if necessary.

II. Instructional materials:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1--Types of Water Erosion
    2. TM 2--Soil Depths
    3. TM 3--Degrees of Slope
    4. TM 4--Strip-Cropping for Erosion Control
    5. TM 5--Terracing for Erosion Control
    6. TM 6--Crop Rotation for Erosion Control
- D. Assignment sheets
    1. Assignment Sheet #1--Locate Good and Poor Conservation Practices
    2. Assignment Sheet #2--Recommend Treatments for Soil Management Problems
- E. Answers to assignment sheets
- F. Test
- G. Answers to test

III. Unit references:

A. Foster, Albert B. *Approved Practices in Soil Conservation*. Danville: The Interstate Printers and Publishers, Inc., 1964.

B. Knuti, Leo L.; Korpi, Milton; and Hide, J.C. *Profitable Soil Management*. 2nd ed. Englewood Cliffs: Prentice-Hall, Inc., 1970.

C. Donahue, Roy L.: Shickluna, John C.; and Robertson, Lynn S. *Soils: An Introduction to Soils and Plant Growth.* 3rd ed. Englewood Cliffs: Prentice-Hall, Inc., 1971.

D. Donahue, Roy L. *Our Soils and Their Management.* Danville: The Interstate Printers and Publishers, Inc., 1961.

E. Buckman, Harry O., and Brady, Nyle C. *The Nature and Properties of Soils.* 9th ed. New York: The Macmillan Company, 1967.

SOIL MANAGEMENT TECHNIQUES
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Erosion--Wearing away of soil by wind and water

B. Volatilization--Release of nutrients into the atmosphere in the form of a gas

C. Grass sod--Grass grown in orchards or waterways to reduce erosion and water runoff

D. Contour farming--Cultivating row crops on the curves of hilly land to prevent erosion

E. Strip cropping--Alternating strips of row crops and soil-retaining crops on the contour to prevent erosion

F. Terracing--Reconstruction of the soil on the contour to hold water and prevent erosion

G. Crop rotation--Growing a series of crops in sequence to avoid continuous plantings of a single crop; prevents soil depletion

H. Intercropping--Growing short-term crops between rows of young trees for full land usage

I. Mulching--Placing material on the soil surface for moisture retention, temperature control, or weed control

J. Contour--Changes in elevation and slope of land

K. Rill--Type of erosion occurring in areas of moderate slope; channels of water erode small notches in the soil

L. Splash--Type of erosion which occurs when water droplets or rain strike the soil surface

M. Sheet--Type of erosion which occurs in nearly flat areas; erosion is equally distributed over an entire area

N. Gully--Type of erosion which occurs in areas of severe slope; channels of water erode large, sometimes uncrossable notches in the soil

O. No till--Land is not cultivated as an erosion control method

(NOTE: This is also known as minimum till.)

II. Types of erosion

A. Wind

INFORMATION SHEET

- B. Water (Transparency 1)
  - 1. Splash
  - 2. Sheet
  - 3. Rill
  - 4. Gully

III. Degrees of erosion

- A. None to slight--Less than 25% of surface soil removed with no gullies
- B. Moderate--25 to 75% of surface soil removed with no gullies
- C. Severe--75% or more of surface soil removed, with occasional uncrossable gullies and/or severe accumulations by wind
- D. Very severe--75% or more of surface soil removed, with frequent uncrossable gullies and/or severe accumulations by wind

IV. Factors involved in soil fertility depletion

- A. Leaching
- B. Erosion
- C. Crop removal
- D. Volatilization

V. Soil depths (Transparency 2, Assignment Sheet #1)

- A. Deep--More than 36 inches deep
- B. Moderately deep--20-36 inches deep
- C. Shallow--10-20 inches deep
- D. Very shallow--Less than 10 inches deep

VI. Degrees of slope (Transparency 3)

- A. Nearly level--Less than one foot fall/100 ft.
- B. Gently sloping--One to three foot fall/100 ft.
- C. Moderately sloping--Three to five foot fall/100 ft.
- D. Strongly sloping--Five to eight foot fall/100 ft.
- E. Steep--Eight to twelve foot fall/100 ft.

INFORMATION SHEET

F. Very steep--More than twelve foot fall/100 ft.

VII. Soil conservation practices

A. Grass sod

B. Contour farming

C. Strip cropping (Transparency 4)

D. Terracing (Transparency 5)

E. Cover crops

VIII. Soil management practices

A. Fertilization

(NOTE: Chemical fertilizers are the principal source of supplemental soil nutrients, although animal manures were used for many years.)

B. Cultivation

(NOTE: If annual plowing is done, vary the depth of plowing to avoid "plowsole" compaction area. Fall plowing is generally recommended.)

C. Crop rotation (Transparency 6)

D. Intercropping

E. Mulching

F. Minimum or no till

IX. Reasons for cultivation

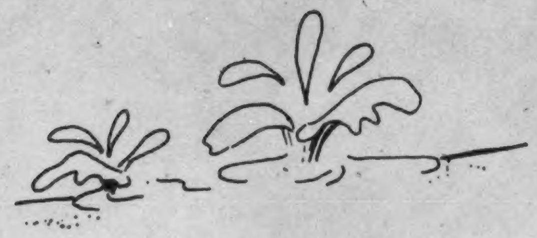
A. Weed control

B. Aeration

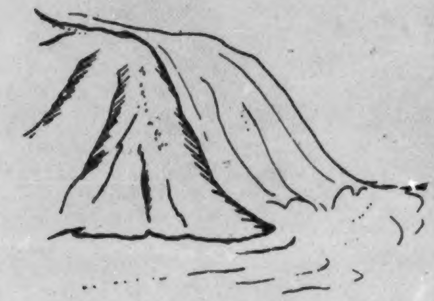
C. Water penetration

D. Incorporation of organic matter

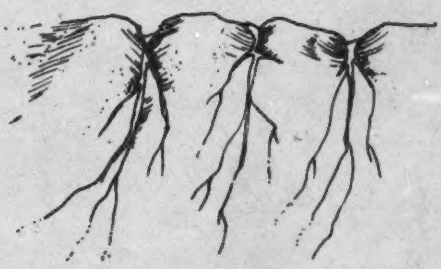
Types Of Water Erosion



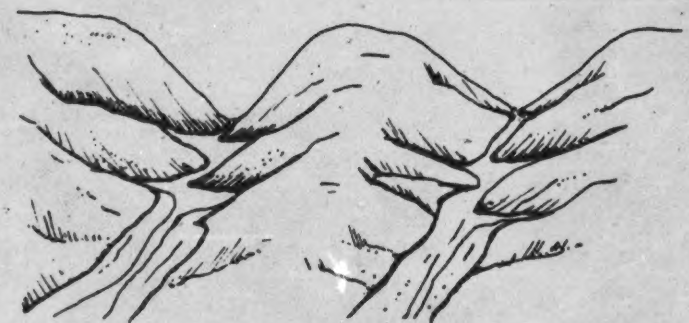
Splash



Sheet

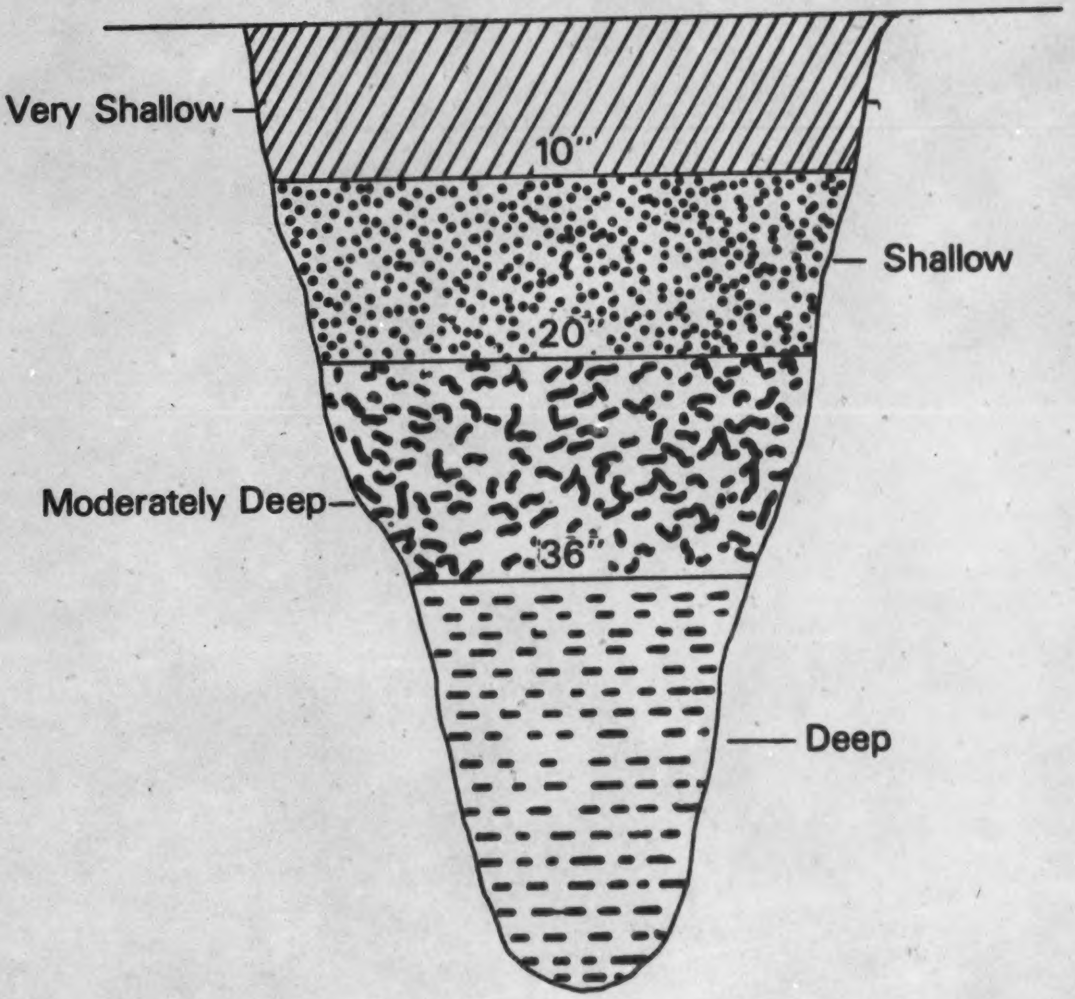


Rill

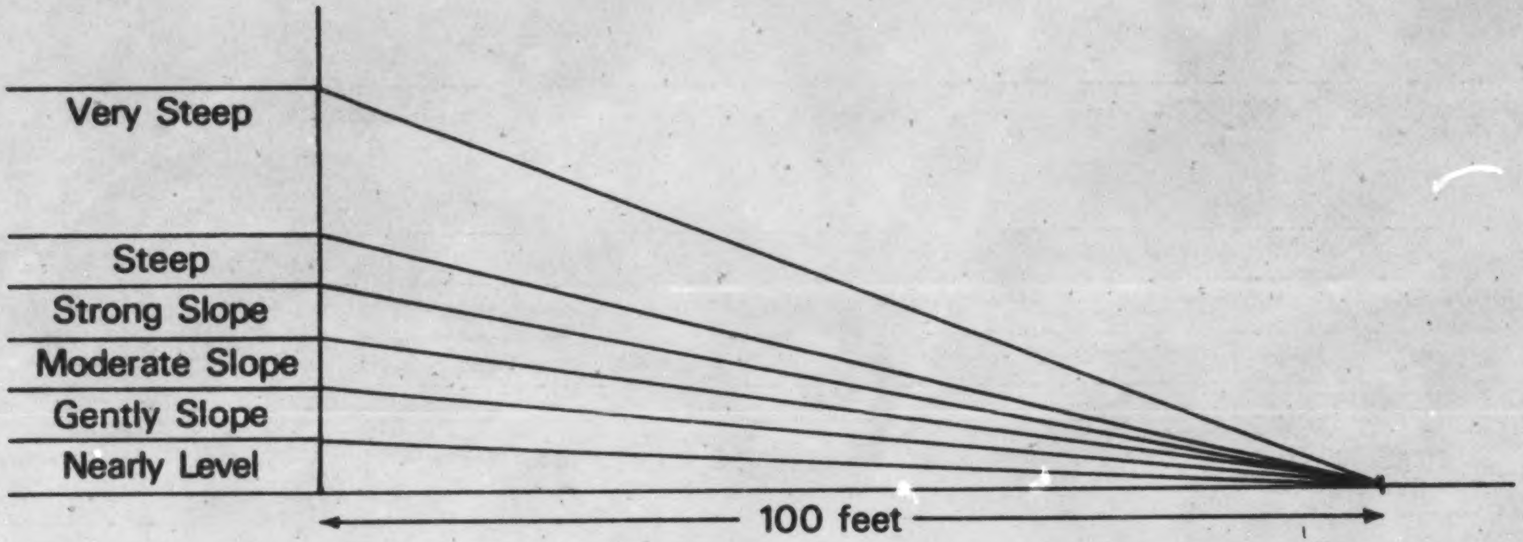


Gully
(Formed From Rills)

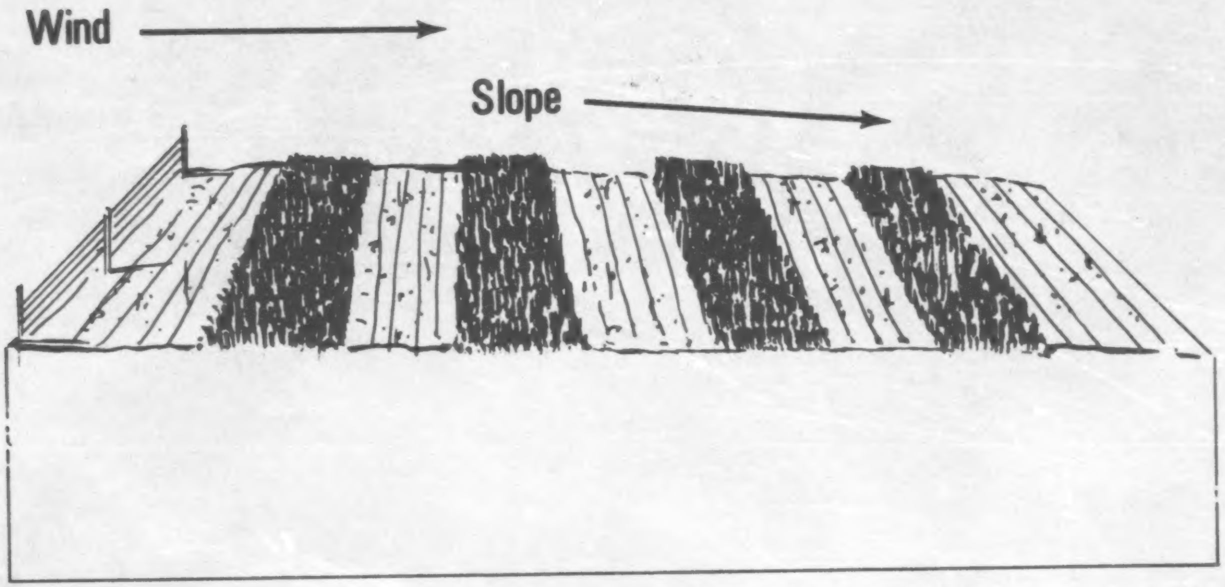
Soil Depths


Very Shallow
10"
Shallow
20"
Moderately Deep
36"
Deep

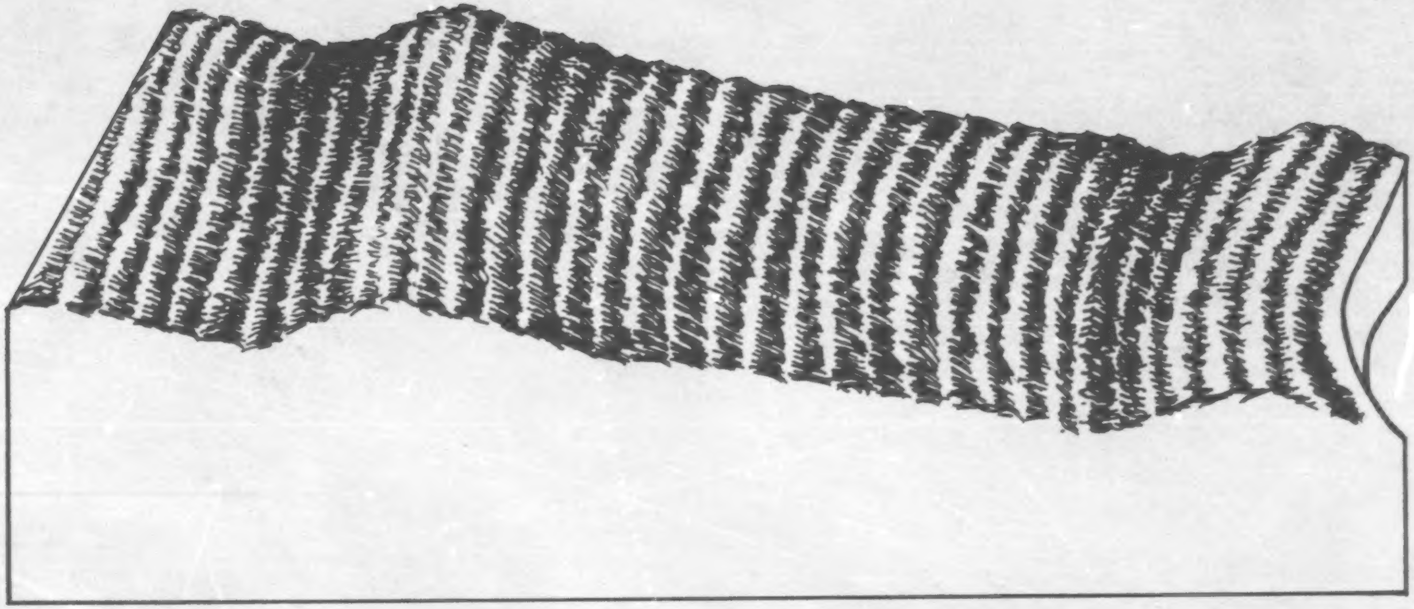
Degrees Of Slope


Very Steep
Steep
Strong Slope
Moderate Slope
Gently Slope
Nearly Level
100 feet

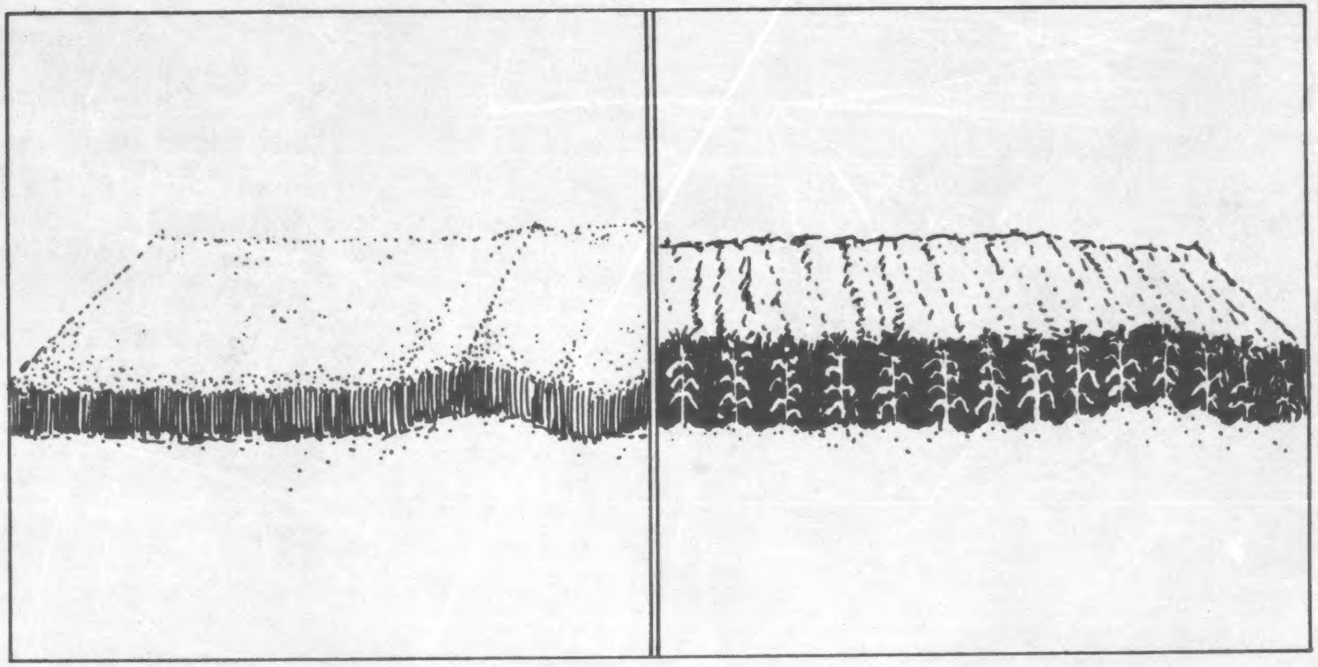
Strip-Cropping for Erosion Control



Terracing for Erosion Control



Crop Rotation for Erosion Control



SOIL MANAGEMENT TECHNIQUES
UNIT II

ASSIGNMENT SHEET #1–LOCATE GOOD AND POOR SOIL CONSERVATION PRACTICES

NAME ______________________________ SCORE ______________.

Take a trip around your community to locate five examples each of good and poor soil conservation practices. Then fill in the charts below and on the next page.

GOOD SOIL CONSERVATION PRACTICES	
LOCATION	DESCRIPTION
1.	
2.	
3.	
4.	
5.	

ASSIGNMENT SHEET #1

POOR SOIL CONSERVATION PRACTICES	
LOCATION	DESCRIPTION
1.	
2.	
3.	
4.	
5.	

SOIL MANAGEMENT TECHNIQUES
UNIT II

ASSIGNMENT SHEET #2–RECOMMEND TREATMENTS FOR SOIL MANAGEMENT PROBLEMS

NAME________________________________ SCORE ______________

1. Farmer Jones has 160 acres of corn. He has planted corn in this location for seven years now and this year the plants are pale green. What do you recommend?

____

____

2. Mr. Bolay has a potential wheat farm but the land is very hilly. What are two practices that would enable him to plant his wheat?

   a. ______________________ b. ______________________

3. Mr Johnson has a problem with erosion in his orchard. What permanent solution will stop the erosion? ____________________________________

____

4. Jane Doe has a commercial field of tomatoes. They seem to be drying out quickly and the soil is hot. What is your solution? ______________________________

____

SOIL MANAGEMENT TECHNIQUES
UNIT II

ANSWERS TO ASSIGNMENT SHEET #2

1. Crop rotation
2. a. Terracing b. Contour farming
3. Grass sod
4. Mulch

SOIL MANAGEMENT TECHNIQUES
UNIT II

TEST

NAME ________________________ SCORE ____________

1. Match terms associated with soil management to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Placing material on the soil surface for moisture retention, temperature control, or weed control

_____b. Wearing away of soil by wind and water

_____c. Growing a series of crops in sequence to avoid continuous plantings of a single crop; prevents soil depletion

_____d. Release of nutrients into the atmosphere in the form of a gas

_____e. Growing short-term crops between rows of young trees for full land usage

_____f. Alternating strips of row crops and soil-retaining crops on the contour to prevent erosion

_____g. Grass grown in orchards or waterways to reduce erosion and water runoff

_____h. Cultivating row crops on the curves of hilly land to prevent erosion

_____i. Reconstruction of the soil on the contour to hold water and prevent erosion

_____j. Type of erosion occurring in areas of moderate slope; channels of water erode small notches in the soil

_____k. Type of erosion which occurs in nearly flat areas; erosion is equally distributed over an entire area

_____l. Type of erosion which occurs when water droplets or rain strike the soil surface

_____m. Land is not cultivated as an erosion control method

1. Terracing
2. Mulching
3. Erosion
4. Inter-cropping
5. Strip cropping
6. Contour farming
7. Grass sod
8. Volatilization
9. Crop rotation
10. Contour
11. Rill
12. Splash
13. Gully
14. Sheet
15. No till

_____n. Type of erosion which occurs in areas of severe slope; channels of water erode large, sometimes uncrossable notches in the soil

_____o. Changes in elevation and slope of land

2. Select from the list below types of erosion. Mark each correct answer with an "X."

_____a. Contour farming
_____b. Evaporation
_____c. Wind
_____d. Rill
_____e. Splash
_____f. Intercropping
_____g. Water
_____h. Gully
_____i. Burning
_____j. Sheet

3. Match degrees of erosion to the correct descriptions. Write the correct numbers in the blanks provided.

_____a. 75% or more of surface soil removed, with frequent uncrossable gullies and/or severe accumulations by wind

_____b. 25 to 75% of surface soil removed with no gullies

_____c. Less than 25% of surface soil removed with no gullies

_____d. 75% or more of surface soil removed, with occasional uncrossable gullies and/or severe accumulations by wind

1. Moderate
2. Severe
3. None to slight
4. Very severe

4. List factors involved in soil fertility depletion.

a. ____
b. ____
c. ____
d. ____

5. List types of soil depths in the spaces below.

a. ____
b. ____
c. ____
d. ____

6. Label the following degrees of soil slope.

__________________ a.

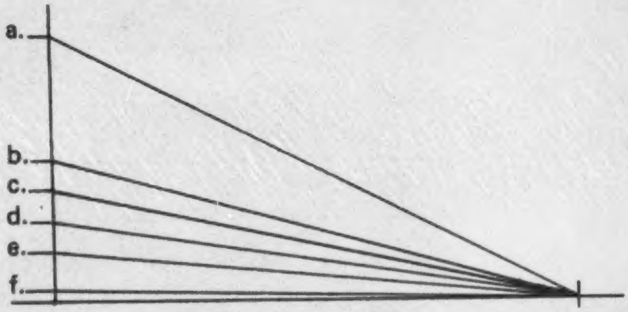
__________________ b.

__________________ c.

__________________ d.

__________________ e.

__________________ f.



7. Select from the list below recommended soil conservation practices. Mark each correct answer with an "X."

_____a. Contour farming

_____b. Strip cropping

_____c. Stubble mulching

_____d. Burning

_____e. Terracing

_____f. Shelterbelt

_____g. Cover crops

_____h. Grass sod

8. Select from the list below recommended soil management practices. Mark each correct answer with an "X."

_____a. Fertilization

_____b. Volatilization

_____c. Intercropping

_____d. Mulching

_____e. Leaching

_____f. Plowsoling

_____g. Crop rotation

_____h. Evaporation

_____i. Cultivation

9. List reasons for cultivation.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

10. Locate good and poor soil conservation practices.

11. Recommend treatments for soil management problems.

    (NOTE: If activities 10 and 11 have not been finished before the test, ask your instructor when they should be completed.)

SOIL MANAGEMENT TECHNIQUES
UNIT II

ANSWERS TO TEST

1. a. 2
   - b. 3
   - c. 9
   - d. 8
   - e. 4
   - f. 5
   - g. 7
   - h. 6
   - i. 1
   - j. 11
   - k. 14
   - l. 12
   - m. 15
   - n. 13
   - o. 10
2. c, d, e, g, h, j
3. a. 4
   - b. 1
   - c. 3
   - d. 2
4. a. Leaching
   - b. Erosion
   - c. Crop removal
   - d. Volatilization
5. a. Very shallow
   - b. Shallow
   - c. Moderately deep
   - d. Deep

6. a. Very steep
   b. Steep
   c. Strongly sloping
   d. Moderately sloping
   e. Gently sloping
   f. Nearly level
7. a, b, e, g, h
8. a, c, d, g, i
9. a. Weed control
   b. Aeration
   c. Water penetration
   d. Incorporation of organic matter
10. Evaluated to satisfaction of instructor
11. Evaluated to satisfaction of instructor

INTRODUCTION TO FERTILIZERS
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to calculate correct rates of fertilizer application. This knowledge will be evidenced by completion of the assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with fertilizers to the correct definitions.
2. Label the components of a complete fertilizer analysis.
3. List types of commercial fertilizers.
4. Select from a list information required on fertilizer bags.
5. Select from a list rules for proper storage of bag fertilizers.
6. Calculate the cost of nitrogen.
7. Calculate the rate of actual phosphorus application.
8. Calculate the rate of actual potassium application.
9. Calculate the cost of a complete fertilizer.

INTRODUCTION TO FERTILIZERS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:
  - A. Provide student with objective sheet and make transparencies.
  - B. Provide student with information and assignment sheets.
  - C. Discuss unit and specific objectives.
  - D. Discuss information sheet.
  - E. Demonstrate and discuss procedures outlined in assignment sheets.
  - F. Obtain samples of different types of fertilizers for the students to observe.
  - G. Take students on a field trip to a plant which manufactures fertilizers.
  - H. Give test.
  - I. Reteach if necessary.

II. Instructional materials:
  - A. Objective sheet
  - B. Information sheet
  - C. Transparency masters:
    1. TM 1-Calculate Cost of Nitrogen
    2. TM 2--Calculate Rate of Actual Phosphorus Application
    3. TM 3--Calculate Rate of Actual Potassium Application
    4. TM 4--Calculate the Cost of Complete Fertilizer
    5. TM 5--Information Required on Fertilizer Bag
  - D. Assignment sheets
    1. Assignment Sheet #1--Calculate Cost of Fertilizers
    2. Assignment Sheet #2--Calculate Rate of Actual Phosphorus and Potassium Applications
  - E. Answers to assignment sheets

F. Test

G. Answers to test

III. Unit references:

A. McVickar, Malcolm H. *Using Commercial Fertilizers.* Danville: The Interstate Printers and Publishers, Inc., 1970.

B. Richardson, William B., and Moore, Gary E. *Working in Horticulture.* Gregg Division: McGraw-Hill Book Company, 1980.

C. Cook, R. L. *Soil Management for Conservation and Production.* New York: John Wiley and Sons, Inc., 1962.

INTRODUCTION TO FERTILIZERS
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Complete fertilizer--Fertilizer containing percentages of nitrogen, phosphorus and potassium

B. Incomplete fertilizer--Fertilizer containing percentages of only one or two of the three major nutrients (nitrogen, phosphorus, and potassium)

C. Granular--Small pelleted form of dry fertilizer

D. Liquid fertilizer--Concentrated liquid which must be diluted before application

E. Liquefied gas--Gas injected under pressure into soil by long tubes ended with blades

F. Slow release--Fertilizer designed for release over an extended period; may be large pellet or prill

G. Prill--Slow-release fertilizer; dry fertilizer core with plastic-type coating designed to activate when wetted

H. Atomic weight--Weight of an element relative to the standard weight of oxygen (16)

I. Conversion factor--Means of converting K_2O and P_2O_5 to actual potassium and phosphorus

J. Macronutrient--Nutrient needed in large quantities for good plant growth

Examples: C, H, O, N, P, K, S, Ca, Mg

K. Micronutrient--Nutrient needed in small quantities for good plant growth

Examples: Fe, Mn, B, Cu, Zn, Mo, Cl

L. Water soluble--Dry form of fertilizer used in greenhouses; applied through injector systems or sprayers

M. Organic fertilizer--Naturally-occurring fertilizer

Example: Bone meal

N. Inorganic fertilizer--Fertilizer artificially created by a chemical process

Examples: Osmocote, 10-20-10

INFORMATION SHEET

II. Complete fertilizer analysis

(NOTE: Complete fertilizers are generally used first, followed by an incomplete fertilizer to provide any additional nutrients needed as determined by soil test.)

A. First number is percent nitrogen (N)

B. Second number is percent phosphorus expressed as P_2O_5

C. Third number is percent potassium expressed as K_2O

D. Sum of numbers equals percent plant food

Example:	10	-	20	-	10	=	40% plant food
	Nitrogen		Phosphorus expressed as P_2O_5		Potassium expressed as K_2O		

(NOTE: The remaining 60% of material is inert ingredients not contributing to nutritional value.)

III. Types of commercial fertilizers

A. Granular

B. Liquid

C. Liquefied gas

D. Slow release

E. Water soluble

IV. Information required on fertilizer bags

A. Name of fertilizer

(NOTE: Name listed may be a brand name or trademark.)

B. Guaranteed analysis

(NOTE: Guaranteed analysis is expressed as percent N, P_2O_5, and K_2O.)

C. Name and address of manufacturer

D. Net weight

INFORMATION SHEET

V. Proper storage of bag fertilizers

- A. Store away from walls
- B. Keep fertilizers as short a time as possible
- C. Store in dry area
- D. Keep bag sealed to prevent moisture absorption
- E. Store away from concrete floors; construct a wooden rack to raise bags
- F. Store away from heaters or open flame

VI. Calculating cost of nitrogen (Transparency 1, Assignment Sheet #1)

- A. Multiply percentage of nitrogen by 2000 pounds (1 ton)
- B. Divide pounds of nitrogen per ton into cost per ton

Example: 21-0-0 = 21% nitrogen

.21 x 2000 = 420. lbs. nitrogen per ton

$140/ton

$$\begin{array}{r} .33 \\ 420\overline{)140.00} \end{array} = \text{33 cents per pound}$$

VII. Calculating rate of actual phosphorus application (Transparency 2, Assignment Sheet #2)

- A. Determine analysis of phosphorus to be used
- B. Multiply analysis phosphorus (P_2O_5) by conversion factor of .44
- C. Set up ratio of

$$\frac{\text{actual P}}{\text{100 lbs.}} \times \frac{\text{lbs desired}}{\text{lb needed to apply "X" amount}}$$

Example: 0-45-0
Need 200 pounds per acre of actual phosphorus

45 x .44 = 19.8 lbs. actual phosphorus in 100 lbs.

$$\frac{\text{19.8 lbs}}{\text{100 lbs.}} \times \frac{\text{200 lbs desired}}{X} \qquad 19.8X = 20000$$

X = 1010.1 pounds of 0-45-0 to supply 200 pounds of actual phosphorus per acre

INFORMATION SHEET

VIII. Calculate rate of actual potassium application (Transparency 3, Assignment Sheet #2)

A. Determine analysis of potassium to be used

B. Multiply analysis potassium (K_2O) by conversion factor of .83

C. Set up ratio of

$$\frac{\text{Actual K}}{\text{100 lbs.}} \times \frac{\text{lbs desired}}{\text{lbs needed}} \text{ to supply "X" amount}$$

Example: 0-0-60

Need 80 pounds per acre of actual potassium

60 x .83 = 49.8 lbs actual potassium in 100 lbs

$$\frac{\text{49.8 lbs}}{\text{100 lbs}} \times \frac{\text{80 lbs desired}}{X} \qquad 49.8X = 8000$$

X = 160.64 pounds of 0-0-60 to supply 80 pounds of actual phosphorus per acre

IX. Calculate cost of complete fertilizer (Transparency 4)

A. Multiply percentage of nitrogen by 2000 pounds (1 ton)

B. Multiply percentage of P_2O_5 by conversion factor (.44)

C. Multiply actual phosphorus by 2000 pounds (1 ton)

D. Multiply percentage of K_2O by conversion factor (.83)

E. Multiply actual potassium by 2000 pounds (1 ton)

F. Add nitrogen, actual phosphorus and actual potassium together for total fertilizer per ton

G. Divide into price per ton

H. Answer is price of fertilizer per pound

Example: 10-20-10 at $250 per ton

10% N x 2000 lbs = 200 lbs/ton

20% P_2O_5 x 2000 lbs x .44 = 176/ton

10% K_2O 2000 lbs x .83 = 166/ton

542 lbs/ton

$542\overline{)\$250/\text{ton}}$ = .46 or 46 cents per pound

Calculate Cost of Nitrogen

1. Multiply percentage of nitrogen by 2000 pounds (1 ton) for pounds of nitrogen per ton

Example: 21-0-0

21% N = .21 x 2000
= 420 pounds
N per ton

2. Divide pounds of nitrogen per ton into cost per ton for cost per pound

Cost of $140/ton

$$\begin{array}{r} .33 \\ 420\,\overline{)\,140.00} \end{array}$$

= 33 cents per pound

Calculate Rate of Actual Phosphorus Application

Example: Need 200 lbs./A.

0-45-0

1. Determine analysis to be used

2. Multiply analysis phosphorus (P_2O_5) by conversion factor of .44

.45 x .44 = 19.8 lbs. actual phosphorus in 100 lbs.

3. Set up ratio of actual phosphorus to 100 lbs. and lbs. desired to lbs. needed to apply specified amount; cross multiply

$$\frac{19.8 \text{ lbs.}}{100 \text{ lbs.}} \times \frac{200 \text{ lbs.}}{X}$$

4. Divide to find lbs. needed to supply specified amount

$$\frac{19.8}{19.8} x = \frac{20000}{19.8}$$

X = 1010.1 lbs. of 0-45-0 to supply 200 lbs. actual phosphorus/A.

Calculate Rate of Actual Potassium Application

Example: Need 80 lbs./A

0-0-60

1. Determine analysis to be used

2. Multiply analysis potassium (K_20) by conversion factor of .83

.60 x .83 = 49.8 lbs.
actual potassium in 100 lbs.

3. Set up ratio of actual potassium to 100 lbs. and lbs. desired to lbs. needed to apply specified amount; cross multiply

$$\frac{49.8\text{ lbs.}}{100\text{ lbs.}} \times \frac{80\text{ lbs.}}{X}$$

4. Divide to find lbs. needed to supply specified amount

$$\frac{49.8\,x}{49.8} = \frac{8000}{49.8}$$

x = 160.64 lbs. of 0-0-60 to supply 80 lbs. actual potassium/A.

Calculate the Cost of Complete Fertilizer

Example: $250/ton for 10-20-10

1. Multiply percentage of nitrogen by 2000 lbs. (1 ton)

   .10 x 2000 = 200 lbs/ton

2. Multiply percentage of P_2O_5 by conversion factor (.44) for actual phosphorus

   .2 x .44 = .088

3. Multiply actual phosphorus by 2000 lbs.

   .088 x 2000 = 176 lbs./ton

4. Multiply percentage of K_2O by conversion factor (.83) for actual potassium

   .10 x .83 = .083

5. Multiply actual potassium by 2000 lbs.

   .083 x 2000 = 166 lbs./ton

6. Add H, P, and K together for total fertilizer per ton

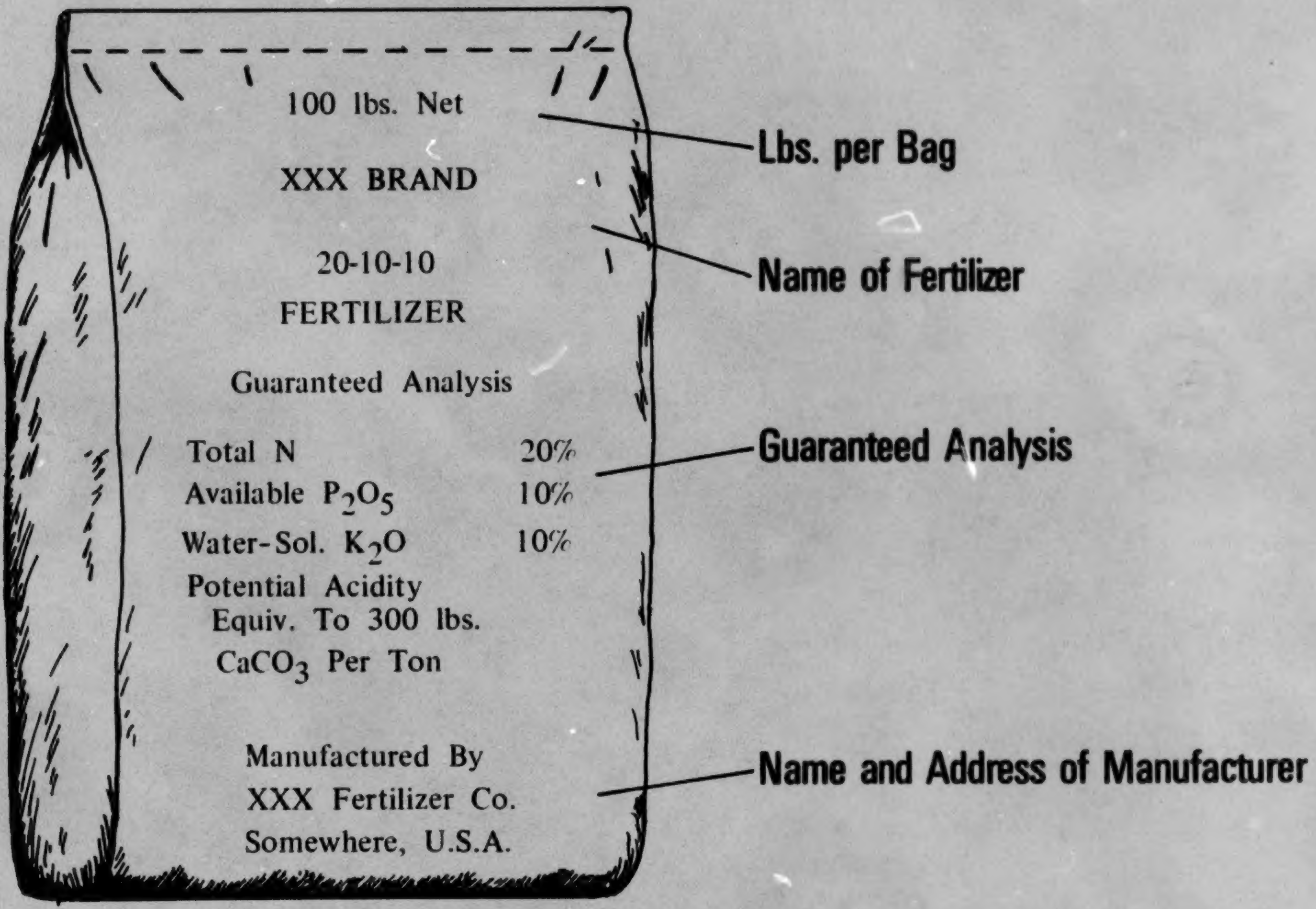
   200 lbs. + 176 lbs. + 166 lbs. = 542 lbs.

7. Divide into price per ton for price per pound

   $$\frac{\$250/\text{ton}}{542\ \text{lbs./ton}} = .46$$

   or 46 cents per pound

Information Required on Fertilizer Bag



100 lbs. Net

XXX BRAND

20-10-10
FERTILIZER

Guaranteed Analysis

Total N	20%
Available P_2O_5	10%
Water-Sol. K_2O	10%

Potential Acidity
Equiv. To 300 lbs.
$CaCO_3$ Per Ton

Manufactured By
XXX Fertilizer Co.
Somewhere, U.S.A.

Lbs. per Bag

Name of Fertilizer

Guaranteed Analysis

Name and Address of Manufacturer

INTRODUCTION TO FERTILIZERS
UNIT I

ASSIGNMENT SHEET #1–CALCULATE COST OF FERTILIZERS

NAME____________________________________ SCORE ________________

Using the formulas learned in this unit, calculate the cost per pound of the fertilizers shown below. Show your work.

1. 45-0-0 at $220 per ton

2. 19-6-12 at $1000 per ton

ASSIGNMENT SHEET #1

3. 0-0-60 at $135 per ton

4. 0-45-0 at $250 per ton

5. 14-14-14 at $1000 per ton

INTRODUCTION TO FERTILIZERS
UNIT I

ASSIGNMENT SHEET #2–CALCULATE RATE OF ACTUAL PHOSPHORUS AND POTASSIUM APPLICATIONS

NAME________________________________ SCORE ____________

Calculate the actual rates of phosphorus and fertilizer applications using formulas learned in this unit. Show your work.

1. Use 0-0-60
   Need 95 pounds actual potassium per acre
   Apply________pounds per acre

2. Use 0-46-0
   Need 150 pounds actual phosphorus per acre
   Apply________pounds per acre

3. Use 0-0-60
   Need 65 pounds actual potassium per acre
   Apply________pounds per acre

ASSIGNMENT SHEET #2

4. Use 0-30-0
   Need 70 pounds actual phosphorus per acre
   Apply________pounds per acre

5. Use 0-20-0
   Need 48 pounds actual phosphorus per acre
   Apply________pounds per acre

INTRODUCTION TO FERTILIZERS
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 24¢ per pound
2. $1.58 per pound
3. 13¢ per pound
4. 63¢ per pound
5. $1.57 per pound

Assignment Sheet #2

1. 190.76 pounds per acre
2. 741.11 pounds per acre
3. 130.52 pounds per acre
4. 530.3 pounds per acre
5. 545.45 pounds per acre

INTRODUCTION TO FERTILIZERS
UNIT I

TEST

NAME____ SCORE ________________

1. Match terms associated with fertilizers to the correct definitions. Write the correct numbers in the blanks provided.

______a. Fertilizer containing percentages of nitrogen, phosphorus, and potassium

______b. Concentrated liquid which must be diluted before application

______c. Fertilizer designed for release over an extended period; may be large pellet or prill

______d. Means of converting K_2O and P_2O_5 to actual potassium and phosphorus

______e. Fertilizer containing percentages of only one or two of the three major nutrients (nitrogen, phosphorus, and potassium)

______f. Small pelleted form of dry fertilizer

______g. Gas injected under pressure into soil by long tubes ended with blades

______h. Slow-release fertilizer; dry fertilizer core with plastic-type coating designed to activate when wetted

______i. Weight of an element relative to the standard weight of oxygen (16)

______j. Dry form of fertilizer used in greenhouses; applied through injector systems or sprayers

______k. Naturally-occurring fertilizer

______l. Nutrient needed in large quantities for good plant growth

______m. Fertilizer artificially created by a chemical process

______n. Nutrient needed in small quantities for good plant growth

1. Incomplete fertilizer
2. Granular
3. Slow release
4. Liquefied gas
5. Complete fertilizer
6. Prill
7. Atomic weight
8. Conversion factor
9. Liquid fertilizer
10. Micronutrient
11. Water soluble
12. Macronutrient
13. Organic fertilizer
14. Inorganic fertilizer

2. Label the components of the following complete fertilizer analysis.

10 - 20 - 10

a. ____________ b. ____________ c. ____________

____________ ____________

3. List five types of commercial fertilizers in the spaces below.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

4. Select from the list below information required on fertilizer bags. Mark each correct answer with an "X."

_____a. Cost

_____b. Name of fertilizer

_____c. Type of filler used

_____d. Name and address of manufacturer

_____e. Recommended crops

_____f. Net weight

_____g. Guaranteed analysis

5. Select from the list below rules for proper storage of bag fertilizers. Mark each correct answer with an "X."

_____a. Store away from concrete floors; construct a wooden rack to raise bags

_____b. Store in moist area to retain freshness

_____c. Store away from walls

_____d. Store in dry area

_____e. Keep fertilizers as short a time as possible

_____f. Store against walls for support

_____g. Store away from heaters or open flame

_____h. Keep bag sealed to prevent moisture absorption

6. Calculate the cost of nitrogen. Show your work.

Use 45-0-0 at $220 per ton
Cost:________per pound

7. Calculate the rate of actual phosphorus application. Show your work.

Use 0-46-0
Need 175 pounds per acre of actual phosphorus
Apply____________pounds per acre

8. Calculate the rate of actual potassium application. Show your work.

Use 0-0-60
Need 75 pounds actual potassium per acre
Apply___________pounds per acre

9. Calculate the cost of a complete fertilizer. Show your work.

Use 18-46-0 at $280 per ton
Cost:____________per pound

INTRODUCTION TO FERTILIZERS
UNIT I

ANSWERS TO TEST

1. a. 5
   b. 9
   c. 3
   d. 8
   e. 1
   f. 2
   g. 4
   h. 6
   i. 7
   j. 11
   k. 13
   l. 12
   m. 14
   n. 10
2. a. Percent nitrogen
   b. Percent phosphorus expressed as P_2O_5
   c. Percent potassium expressed as K_2O
3. a. Granular
   b. Liquid
   c. Liquefied gas
   d. Slow release
   e. Water soluble
4. b, d, f, g
5. a, c, d, e, g, h
6. 24¢ per pound
7. 814.24 pounds per acre
8. 150.6 pounds per acre
9. 36¢ per pound

METHODS OF FERTILIZER APPLICATION
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to state ways to apply different types of fertilizers correctly, and calculate fertilizer application. This knowledge will be evidenced by completion of the assignment sheet and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of the unit, the student should be able to:

1. Match methods of fertilizer application with their descriptions.
2. Match fertilizers used with application methods.
3. List factors affecting time of application.
4. List methods for determining rate of application.
5. Label equipment used for fertilizer application.
6. Calculate fertilizer application.

METHODS OF FERTILIZER APPLICATION
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Discuss procedures outlined in the assignment sheet.

   F. Demonstrate fertilizer application methods with various pieces of equipment.

   G. Give test.

   H. Reteach if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Assignment Sheet #1--Calculate Fertilizer Application

   D. Answers to assignment sheet

   E. Test

   F. Answers to test

III. Unit references:

   A. McVickar, Malcolm H. *Using Commercial Fertilizers.* Danville, IL: The Interstate Printers and Publishers, Inc., 1970.

   B. Jones, Ulysses S. *Fertilizers and Soil Fertility.* Reston, VA: Reston Publishing Company, 1979.

   C. Cook, R. L. *Soil Management for Conservation and Production.* New York: John Wiley and Sons, Inc., 1962.

METHODS OF FERTILIZER APPLICATION
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Broadcasting--Fertilizer is applied uniformly on the soil surface before planting; may be incorporated by disking

B. Incorporate--To mix or blend in

C. Banding--Band of fertilizer is placed 2 to 3 inches to the side of the seed and/or 3 to 5 inches below the seed

(NOTE: Direct contact of fertilizer with the seed may prevent germination or damage the young plant.)

D. Sidedressing--Fertilizer is applied between the rows at recommended stage of growth depending on crop, usually at first cultivation

E. Topdressing--Fertilizer is placed on top of soil or drilled into the topsoil using a drill attachment

(NOTE: Topdressing is used on grains and grasses and is similar to sidedressing method used on row crops.)

F. Injection into irrigation water--Fertilizer is injected into irrigation system in measured amounts for even distribution

G. Foliar spray--Fertilizer is sprayed on the leaves of the plant; good method for supplying micronutrients

H. Aerial spray--Granular material is applied by airplane to areas difficult to cultivate

Examples: Forests, rough areas

I. Starter solution--Fertilizer solution is applied at transplanting to provide an immediate source of nutrients

J. Liquefied gas--Ammonia gas is injected under pressure into the soil

(NOTE: This method is not used on perennial crops because the injector blades prune roots back; the soil must be well tilled so it will fall back in place quickly and prevent escape of gas.)

II. Fertilizers used with application methods

A. Broadcast--Granular, slow release

B. Banding--Granular

C. Sidedressing--Granular

INFORMATION SHEET

- D. Topdressing--Granular, slow release
- E. Injection into irrigation water-Liquid, total water soluble
- F. Foliar spray--Liquid, total water soluble
- G. Aerial spray--Granular
- H. Starter solution--Liquid, total water soluble
- I. Liquefied gas--Gas

III. Factors affecting time of application

- A. Type of crop
- B. Time of planting
- C. Land preparation
- D. Climatic conditions
- E. Stage of growth of crop
- F. Irrigation availability

IV. Methods for determining rate of application

- A. Soil test

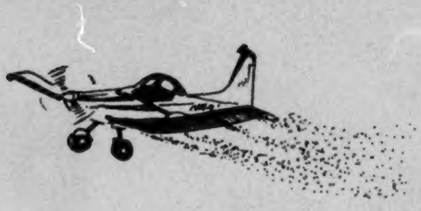
  (NOTE: This test is used to determine nutritional levels and soil type.)

- B. Leaf analysis

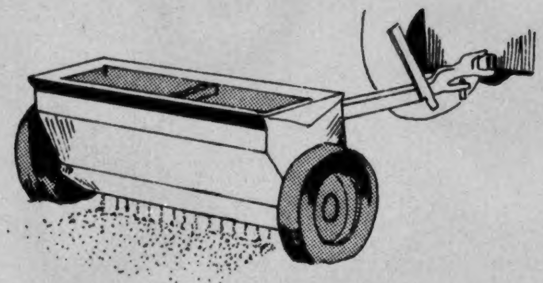
  (NOTE: This test uses leaf samples to determine nutritional problems.)

INFORMATION SHEET

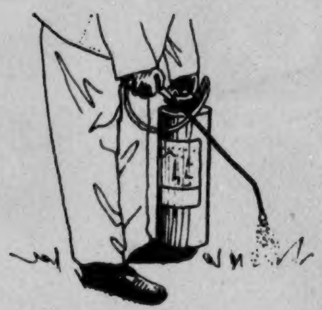
V. Equipment used for fertilizer application



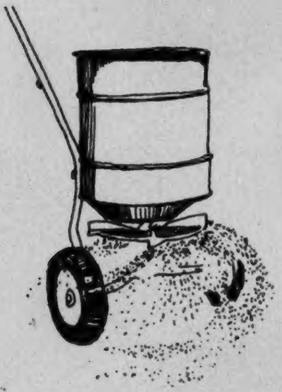
Airplane



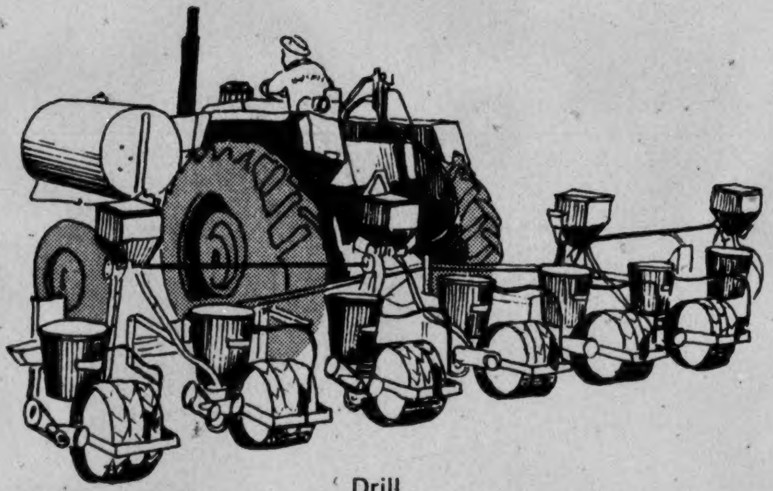
Conventional Spreader



Sprayer



Whirlybird Spreader



Drill

METHODS OF FERTILIZER APPLICATION
UNIT II

ASSIGNMENT SHEET #1--CALCULATE FERTILIZER APPLICATION

NAME______________________________________ SCORE________________

As a homeowner, you will need to be able to calculate fertilizer applied to a given area. Work the following problems following the examples given.

Examples:

A. Using a spreader to apply a granular fertilizer, you are going to apply 10 pounds of 10-20-10 per 1000 square feet. Your yard is 15,000 square feet. How much fertilizer will you need?

$$\frac{10 \text{ pounds}}{1000 \text{ ft.}} \times \frac{x}{15{,}000} = 150{,}000 \text{ pounds} = 1000x = 150 \text{ lbs.}$$

B. If your 4 ft. spreader emits 12 pounds per 1000 square feet, how many feet must you travel to spread 6 pounds?

(NOTE: You should always walk at the same pace to insure even distribution.)

$$\frac{1000 \text{ sq. ft.}}{4 \text{ ft}} = 250 \text{ ft. for 12 pounds}$$

$$\frac{12}{250} \quad \frac{6}{x} \quad \begin{aligned} 12\,x &= 15000 \\ x &= 125 \text{ ft.} \end{aligned}$$

1. Mrs. Howard wants to apply a granular fertilizer to her yard. Her extension agent has told her to apply 25 pounds of 0-45-0 per 1000 square feet. Her yard has a total of 475 square feet. How much fertilizer will she need?

2. Walking at a moderate pace, Mr. Cahill can put down 18 pounds of a granular fertilizer per 1000 square feet with his 2 1/2 foot wide spreader. How long a distance will he be able to walk before the 18 pounds is gone?

ASSIGNMENT SHEET #1

3. Miss Wheless needs to apply 8 pounds per 1000 square feet of 33-0-0 to her backyard area. Since her yard is 18,600 square feet, how many pounds of fertilizer will she need?

4. Your spreader can put down 25 pounds per 1000 square feet. If your spreader is 2 1/2 feet wide, how far will you be able to travel to spread 15 pounds of fertilizer?

METHODS OF FERTILIZER APPLICATION
UNIT II

ANSWERS TO ASSIGNMENT SHEET #1

1. 11.875 pounds
2. 400 feet
3. 148.8 pounds
4. 320 feet

METHODS OF FERTILIZER APPLICATION
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match methods of fertilizer application to the correct descriptions. Write the correct numbers in the blanks provided.

_____ a. Fertilizer is injected into irrigation system in measured amounts for even distribution

_____ b. Fertilizer is applied between the rows at recommended stage of growth depending on crop, usually at first cultivation

_____ c. To mix or blend in

_____ d. Fertilizer is applied uniformly on the soil surface before planting; may be incorporated by disking

_____ e. Band of fertilizer is placed 2 to 3 inches to the side of the seed and/or 3 to 5 inches below the seed

_____ f. Fertilizer is placed on top of soil or drilled into the topsoil using a drill attachment

_____ g. Ammonia gas is injected under pressure into the soil

_____ h. Granular material is applied by airplane to areas difficult to cultivate

_____ i. Fertilizer is sprayed on the leaves of the plant; good method for supplying micronutrients

_____ j. Fertilizer solution is applied at transplanting to provide an immediate source of nutrients

1. Sidedressing
2. Topdressing
3. Banding
4. Broadcasting
5. Injection into irrigation water
6. Foliar spray
7. Aerial spray
8. Starter solution
9. Liquefied gas
10. Incorporate

2. Match fertilizers used with application methods. Write the correct numbers in the blanks provided. Answers may be used more than once.

_____ a. Broadcast

_____ b. Banding

_____ c. Sidedressing

_____ d. Topdressing

1. Granular
2. Slow release
3. Liquid
4. Gas
5. Total water soluble

_____e. Injection into irrigation water

_____f. Foliar spray

_____g. Aerial spray

_____h. Starter solution

_____i. Liquefied gas

3. List factors affecting time of application.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

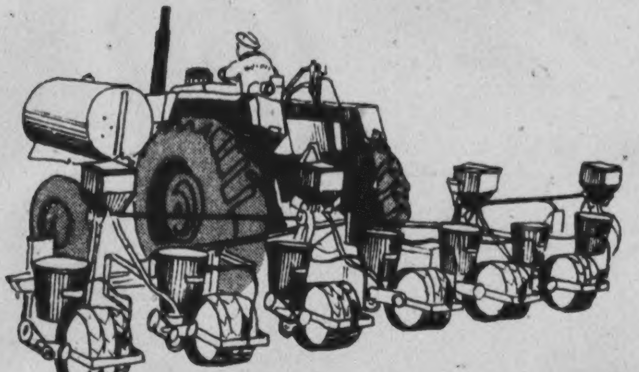
f. ______________________________

4. List methods for determining rate of application.

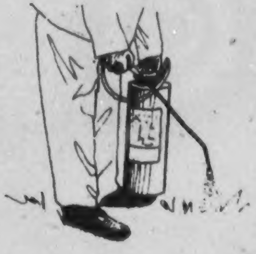
a. ______________________________

b. ______________________________

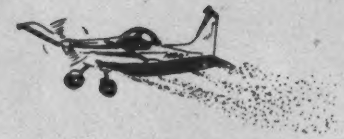
5. Label the following pieces of equipment used for fertilizer application shown below and on the next page. Write the correct names in the blanks provided.



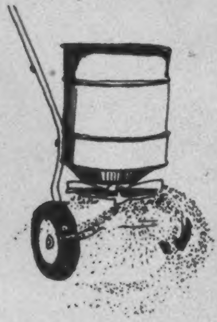
a. ______________________________

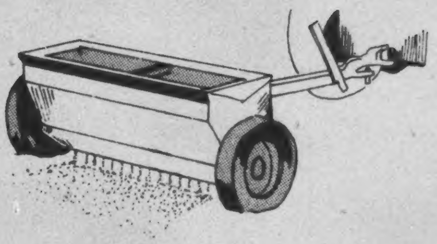


b. ______________________________



c. ____________________





e. ____________________

d. ____________________

6. Calculate fertilizer application by solving the two problems below. Show your work.

   a. You want to apply a granular fertilizer to your garden. The recommended rate is 30 pounds of 10-20-10 per 1000 square feet. Your garden has 400 square feet. How much fertilizer do you need?

   b. Your fertilizer spreader emits 20 pounds of granular fertilizer per 1000 square feet. Your spreader is 2 1/2 feet wide. How far must you travel to spread 32 pounds?

METHODS OF FERTILIZER APPLICATION
UNIT II

ANSWERS TO TEST

1. a. 5
   - b. 1
   - c. 10
   - d. 4
   - e. 3
   - f. 2
   - g. 9
   - h. 7
   - i. 6
   - j. 8
2. a. 1, 2
   - b. 1
   - c. 1
   - d. 1, 2
   - e. 3, 5
   - f. 3, 5
   - g. 1
   - h. 3, 5
   - i. 4
3. a. Type of crop
   - b. Time of planting
   - c. Land preparation
   - d. Climatic conditions
   - e. Stage of growth of crop
   - f. Irrigation availability
4. a. Soil test
   - b. Leaf analysis

5. . Drill
    b. Sprayer
    c. Airplane
    d. Whirlybird spreader
    e. Conventional spreader

6. a. 12 pounds
    b. 640 feet

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to calculate drainable pore space and mix medium with a concrete mixer. This knowledge will be evidenced by completion of the assignment sheet, job sheets, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with media to the correct definitions.
2. List requirements for a good plant medium.
3. State advantages of a porous soil.
4. Distinguish among materials used in mixing soil media.
5. Identify soil media materials.
6. Calculate drainable pore space.
7. Mix medium with a concrete mixer.

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information, assignment, and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Show students examples of soil media materials.

   G. Invite a local greenhouse owner or area grower to discuss reasons for using different media.

   H. Prepare media materials for Assignment Sheet #1.

   I. Give test.

   J. Reteach, if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Assignment Sheet #1--Identify Soil Media Materials

   D. Job sheets

      1. Job Sheet #1--Calculate Drainable Pore Space

      2. Job Sheet #2--Mix Medium with a Concrete Mixer

   E. Test

   F. Answers to test

III. Unit references:

   A. *The Ball Red Book.* Chicago: George J. Ball, Inc., 1975.

   B. *Garden Seed Product Information Manual.* Downers Grove, IL: Vaughans' Seed Company, 1971.

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

INFORMATION SHEET

I. Terms and definitions

- A. Medium--Mixture of several materials for use in growing plants in containers; may or may not contain soil

  (NOTE: The plural of medium is media.)

- B. Porous--Having good drainage and aeration; will not pack and allows good water movement
- C. Organic matter--Plant and animal residues used to loosen soil and hold water
- D. Natural soils--Soils as they appear without any additives such as peat moss or vermiculite
- E. Soil conditioner--Media additive which improves soil structure by preventing compaction, improving aeration and water holding capacity
- F. Drainable pore space--Percentage of air in a soil mix after drainage of a soil saturated with water

II. Requirements for a good plant medium

- A. Correct pH for crop grown
- B. Good water holding capacity
- C. Sterile

  NOTE: Sterilization should be used in greenhouse operations but is not feasible outdoors.)

- D. Good porosity
- E. Good support for plant material
- F. Little shrink and swell

III. Advantages of a porous soil

- A. Good drainage
- B. Aeration

INFORMATION SHEET

IV. Materials used in mixing soil media

A. Organic matter

1. Peat moss

2. Bark

3. Leaf mold

(NOTE: Leaf mold is not used on a commercial basis, but is used by homeowners.)

4. Sawdust

(NOTE: Sawdust is not used in greenhouse operations.)

5. Compost

(NOTE: Compost is not used on a commercial basis, but is used by homeowners.)

B. Natural soils

1. Topsoil

2. Sand

C. Soil conditioners

1. Vermiculite

2. Perlite

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

ASSIGNMENT SHEET #1–IDENTIFY SOIL MEDIA MATERIALS

NAME ______________________________ SCORE ______________

As a horticulturist, you will need to be able to identify materials used in mixing media. Label the samples of media materials assembled by your instructor.

	Check one					
Name	Organic Matter	Natural Soil	Soil Conditioner	Source	Cost/lb.	Comment

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

JOB SHEET #1--CALCULATE DRAINABLE PORE SPACE

I. Materials and equipment

- A. Two containers with drain holes
- B. Masking tape
- C. Media
  - 1. 1 bark, 1 sand, 1 peat
  - 2. 2 peat, 1 perlite, 1 sand
- D. Water
- E. Measuring cup

II. Procedure

- A. Select pot to be used
- B. Tape drainholes shut
- C. Fill pot firmly with medium
- D. Add a measured amount of water
- E. Continue adding measured water until soil is saturated
- F. Remove tape and catch draining water in another container
- G. Measure drainage water
- H. Divide returned water by total water added for drainable pore space
- I. Record information

	MIX #1	MIX #2
Components of Mix		
Pot size		
Water added		
Water returned		
Drainable pore space		

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

JOB SHEET #2--MIX MEDIUM WITH A CONCRETE MIXER

I. Materials and equipment

A. Media materials

(NOTE: These will vary with instructor's preference.)

B. Concrete mixer

C. Wheelbarrow

D. Shovel

E. Water hose

F. Granular or slow-release fertilizer

(NOTE: If media is not for immediate use, do not add fertilizers at time of mixing, to avoid fertilizer leaching to bottom of storage unit.)

II. Procedure

A. Place specified amounts of materials in concrete mixer

B. Add enough water to prevent dust and mix small amount of moisture throughout the mix

C. Turn on mixer and mix until well blended

D. Dump mix into wheelbarrow

E. Place in storage bin

(NOTE: Media should be stored in a dry area.)

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

TEST

NAME _______________________________ SCORE _______________

1. Match terms associated with media to their correct definitions. Write the correct numbers in the blanks provided.

_____ a. Having good drainage and aeration; will not pack and allows good water movement

_____ b. Percentage of air in a soil mix after drainage of a soil saturated with water

_____ c. Plant and animal residues used to loosen soil and hold water

_____ d. Media additive which improves soil structure by preventing compaction, improving aeration and water holding capacity

_____ e. Mixture of several materials for use in growing plants in containers; may or may not contain soil

_____ f. Soils as they appear without any additives such as peat moss or vermiculite

1. Medium
2. Porous
3. Organic matter
4. Natural soils
5. Soil conditioner
6. Drainable pore space

2. List requirements for a good plant medium in the spaces below.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

3. State advantages of a porous soil in the spaces below.

a. ____

b. ____

4. Distinguish among materials used in mixing soil media. Write an "OM" for organic matter, "N" for natural soil, and "SC" for soil conditioner.

_____a. Bark

_____b. Topsoil

_____c. Vermiculite

_____d. Sawdust

_____e. Leaf mold

_____f. Perlite

_____g. Compost

_____h. Sand

_____i. Peat moss

5. Identify soil media materials.

6. Calculate drainable pore space.

7. Mix medium with a concrete mixer.

(NOTE: If activities 5-7 have not been finished before the test, ask your instructor when they should be completed.)

INTRODUCTION TO PLANT GROWTH MEDIA
UNIT I

ANSWERS TO TEST

1. a. 2 d. 5
   b. 6 e. 1
   c. 3 f. 4

2. a. Correct pH for crop grown
   b. Good water holding capacity
   c. Sterile
   d. Good porosity
   e. Good support for plant material
   f. Little shrink and well

3. a. Good drainage
   b. Aeration

4. a. OM f. SC
   b. N g. OM
   c. SC h. N
   d. OM i. OM
   e. OM

5. Evaluated to satisfaction of instructor

6. Performance skills evaluated to satisfaction of instructor

7. Performance skills evaluated to satisfaction of instructor

SOIL STERILANTS AND SOIL STERILIZATION
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to sterilize soil. This knowledge will be evidenced by completion of the job sheet and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Name terms associated with soil sterilization when given the definitions.
2. Select from a list reasons for soil sterilization.
3. List methods of sterilization.
4. Arrange in order the steps for soil preparation for steam sterilization.
5. State the time and temperature required for the steaming procedure.
6. Describe problems of steaming.
7. Select from a list solutions to steaming problems.
8. Describe one method of sterilization by dry heat.
9. Select from a list cases when chemical sterilization is used.
10. Select from a list factors affecting fumigation.
11. Select from a list commonly-used chemical fumigants.
12. Name three methods of chemical application.
13. List precautions for chemical application.
14. Demonstrate the ability to sterilize soil by steam.

SOIL STERILANTS AND SOIL STERILIZATION
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for the instructor:

- A. Provide student with objective sheet.
- B. Provide student with information and job sheets.
- C. Discuss unit and specific objectives.
- D. Discuss information sheet.
- E. Demonstrate and discuss procedures outlined in the job sheet.
- F. Purchase steam equipment.
- G. Discuss precautions to be taken while using chemicals.
- H. Give test.
- I. Reteach, if necessary.

II. Instructional materials:

- A. Objective sheet
- B. Information sheet
- C. Job Sheet #1--Sterilize Soil by Steam
- D. Test
- E. Answers to test

III. Unit references:

- A. *The Ball Red Book.* Chicago: George J. Ball, Inc., 1975.
- B. Hartman, H.I.; and Kester, D.E. *Plant Propagation: Principles and Practices.* Englewood Cliffs: Prentice-Hall, Inc., 1974.
- C. *Nursery Operations: Unit Guide 4-Media Preparation.* Tallahassee: State of Florida Department of Education, 1977.

SOIL STERILANTS AND SOIL STERILIZATION
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Sterilizing--Treating soils to kill weed seeds, nematodes, and harmful microorganisms

   B. Nematode--A microscopic roundworm which lives in soil and usually damages plant roots

   C. Leaching--Flooding out toxic materials from the soil

   D. Fumigant--Chemical whose vapors can destroy insects, microorganisms, diseases, and weed seeds in the soil

II. Reasons for soil sterilization

   (NOTE: There are soil sterilants which completely kill the soil and prevent all growth for several years. Since they serve a different purpose than the chemicals discussed, they will not be covered in this unit.)

   A. Control disease

   B. Kill weed seeds

   C. Kill insects

   D. Kill harmful microorganisms

   Examples: Viruses, bacteria, fungi

III. Methods of sterilization

   A. Steam

   B. Dry heat

   C. Chemical

IV. Soil preparation for steam sterilization

   A. Add humus or organic matter

   B. Water soil to normal moisture content for potting

   C. Keep soil moist one week before steaming to encourage weed seed germination

   (NOTE: Weeds are easier to kill after germination.)

INFORMATION SHEET

D. Unroll canvas steaming hose down the bench if raised benches are to be sterilized

E. Cover raised benches with 6 mL poly and clamp in place

(NOTE: Steam only those parts of the medium that are not already sterile. Artificial media do not need sterilization.)

V. Steaming procedure--Steam soil for 30 minutes after coldest part has reached 180°

VI. Problems of steaming

A. Beneficial bacteria may be killed

B. Ammonia may build up in the soil, causing root burn or stunting of the plant, which occurs two to three weeks after sterilization

VII. Solutions to steaming problems

A. Use German peat, Canadian peat, or other forms of organic matter which break down slowly

B. Avoid sterilizing in hot weather

C. Don't feed crop after flower buds are showing color; leach it during the final waterings

D. Keep soil medium moist but prevent overaccumulation of water when steaming, as wet soils encourage ammonia build-up

E. Add four pounds of gypsum or 40% superphosphate per 100 cubic feet immediately after steaming to help tie up free ammonia and encourage beneficial nitrifying bacteria

F. Leach heavily after steaming

(NOTE: Use of artificial soil mixes may eliminate after-steaming problems.)

VIII. Sterilization by dry heat

A. Bury electrical cables which heat to 160-180°F

(NOTE: Buried cable is expensive to install but inexpensive and easy to operate.)

B. Use a sterilization box which heats soil to 160-180°F

(NOTE: Units are available to heat 1/3 cubic yard and larger.)

INFORMATION SHEET

IX. When chemical sterilization is used

- A. Used when overhead is low enough that time required for aeration is not expensive
- B. Used when weed seeds and soil insects are primary reasons for sterilization
- C. Used when steam boilers or electrical systems are not available
- D. Good for large quantities
- E. Can be done in slack periods

X. Factors affecting fumigation

- A. Soil temperature
- B. Soil moisture
- C. Soil texture
- D. Soil type
- E. Organic matter
- F. Depth of application
- G. Seals needed

XI. Commonly-used chemical fumigants

- A. Methyl bromide

  (**CAUTION**: Methyl bromide should never be used by inexperienced personnel.)
- B. Vapam
- C. Trizone
- D. Chloropicrin
- E. Dexon (Lesan)
- F. Terrachlor

  (NOTE: These fumigants are effective against various microorganisms. Check labels for specific uses.)

INFORMATION SHEET

XII. Methods of chemical application

A. Dissolve in water and meter into irrigation system

B. Tractor-mounted equipment which lays plastic and injects the material under the plastic

C. Hand-operated needlepoint injector guns

D. Pressure cylinders are released under plastic covers

E. Tractor-mounted chisel-tooth injection shanks

F. Granules, powders or liquids worked into the soil from rototiller-mounted equipment

(NOTE: Check label for recommended method of application.)

XIII. Precautions for chemical application

A. Follow label instructions

B. Avoid inhaling chemical

C. Avoid contact with skin

D. Allow sufficient time for aeration after application

E. Do not replant for recommended length of time

SOIL STERILANTS AND SOIL STERILIZATION
UNIT II

JOB SHEET #1--STERILIZE SOIL BY STEAM

I. Equipment and materials

- A. Growing medium
- B. Steam hose
- C. Boiler
- D. Steam bench, bin, box, or trailer
- E. Poly cover (6 mL)
- F. Probe thermometer

II. Procedure

A. Test soil moisture

(NOTE: Correct moisture content will hold soil in a ball shape. If soil is too wet, allow to dry several days. If soil is too dry, add small amount of water, mix, and retest.)

B. Place soil in bench, bin, box or trailer

C. Connect steam hose with source

D. Place hose over soil at edge of mound or connect to box or trailer

E. Place polycover over soil, using heavy items such as pipe lengths over the cover to hold in place

F. Slowly open steam valve until cover is lifted off medium

(**CAUTION:** Be careful not to overinflate cover, or it may blow off.)

G. Place thermometer through the cover at the end farthest from the steam source. Heat until thermometer registers 180°F, and continue to heat for 30 minutes

(**CAUTION:** When placing thermometer through cover, be *very careful* - steam burns skin very easily and quickly.)

H. Turn off steam after 30 minutes and remove the cover carefully to avoid getting burned

I. Allow soil to cool

SOIL STERILANTS AND SOIL STERILIZATION
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Name terms associated with soil sterilization when given the definitions. Write the correct names in the blanks provided.

______________ a. A microscopic round worm which lives in soil and usually damages plant roots

______________ b. Treating soils to kill weed seeds, nematodes, and harmful microogranisms

______________ c. Flooding out toxic materials from the soil

______________ d. Chemical whose vapors can destroy insects, microorganisms, diseases, and weed seeds in soil

2. Select from a list reasons for soil sterilization. Mark each correct answer with an "X."

_____ a. Control disease

_____ b. Stimulate plant growth

_____ c. Promote weed seed germination

_____ d. Kill insects

_____ e. Prevent growth of plants

_____ f. Kill weed seeds

_____ g. Kill harmful microorganisms

3. List methods of sterilization in the spaces below.

a. ____

b. ____

c. ____

4. Arrange in order the steps for soil preparation for steam sterilization. Write a "1" for the first step, a "2" for the second step, and so on.

_____ a. Cover raised benches with 6 mL poly and clamp in place

_____ b. Add humus or organic matter

_____c. Keep soil moist one week before steaming to encourage weed seed germination

_____d. Unroll canvas steaming hose down the bench if raised benches are to be sterilized

_____e. Water soil to normal moisture content for potting

5. State the time and temperature required for the steaming procedure.

____

6. Describe problems of steaming in the spaces below.

____

____

____

____

____

7. Select from the list below solutions to steaming problems. Mark each correct answer with an "X."

_____a. Sterilize in hot weather

_____b. Use German peat, Canadian peat, or other forms of organic matter which break down slowly

_____c. Keep soil very wet when steaming

_____d. Don't feed crop after flower buds are showing color; leach it during the final waterings

_____e. Add eight pounds of gypsum or 40% superphosphate per 100 square feet immediately after steaming to help tie up the free ammonia and encourage beneficial nitrifying bacteria

_____f. Leach heavily after steaming

8. Describe one method of sterilization by dry heat.

____

____

____

9. Select from the list below cases when chemical sterilization is used. Mark each correct answer with an "X."

_____a. Used when steam boilers or electrical systems are not available

_____b. Used when bacteria are the primary reason for sterilization

_____c. Used when overhead is low enough that time required for aeration is not expensive

_____d. Used when fertility needs to be increased

_____e. Good for large quantities

_____f. Can be done in slack periods

10. Select from the list below factors affecting fumigation. Mark each correct answer with an "X."

_____a. Soil type

_____b. Soil moisture

_____c. Air temperature

_____d. Organic matter

_____e. Date of application

_____f. Vermiculite

_____g. Soil temperature

_____h. Depth of application

_____i. Seals needed

_____j. Soil texture

_____k. Humidity

11. Select from the list below commonly-used chemical fumigants. Mark each correct answer with an "X." Terms continue on the next page.

_____a. Vapam

_____b. Malathion

_____c. Diesel

_____d. Methyl bromide

_____e. Trizone

_____f. Decon

_____g. Dexon (Lesan)

_____h. Terrachlor

_____i. Chloropicrin

12. Name three methods of chemical application.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

13. List precautions for chemical application.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

14. Demonstrate the ability to sterilize soil by steam.

(NOTE: If this activity has not been finished before the test, ask your instructor when it should be completed.)

SOIL STERILANTS AND SOIL STERILIZATION
UNIT II

ANSWERS TO TEST

1. a. Nematode

   b. Sterilizing

   c. Leaching

   d. Fumigant

2. a, d, f, g

3. a. Steam

   b. Dry heat

   c. Chemical

4. a. 5 d. 4

   b. 1 e. 2

   c. 3

5. Steam soil for 30 minutes after coldest part has reached 180°F

6. Description should include:

   a. Beneficial bacterial may be killed

   b. Ammonia may build up in the soil, causing root burn or stunting of the plant, which occurs two to three weeks after sterilization

7. b, d, f

8. Either of the following:

   a. Bury electrical cables which heat to 160-180°F

   b. Use a sterilization box which heats soil to 160-180°F

9. a, c, e, f

10. a, b, d, g, h, i, j

11. a, d, e, g, h, i

12. Any three of the following:
    - a. Dissolve in water and meter into irrigation system
    - b. Tractor-mounted equipment which lays plastic and injects the material under the plastic
    - c. Hand-operated needlepoint injector guns
    - d. Pressure cylinders are released under plastic covers
    - e. Tractor-mounted chisel-tooth injection shanks
    - f. Granules, powders or liquids worked into the soil from rototiller-mounted equipment
13. a. Follow label instructions
    - b. Avoid inhaling chemical
    - c. Avoid contact with skin
    - d. Allow sufficient time for aeration after application
    - e. Do not replant for recommended length of time
14. Performance skills evaluated to satisfaction of instructor

CHEMICAL SAFETY
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to demonstrate the ability to apply pesticides safely. This knowledge will be evidenced by completion of the assignment sheets and unit test with at least 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with pesticides to the correct definitions.
2. Match classifications of pesticides to the correct definitions.
3. Match ways pesticides work to the correct descriptions.
4. Compare toxicity of pesticides.
5. Select from a list forms of pesticides.
6. Match pesticide information to a sample pesticide label.
7. Select from a list precautions for chemical safety.
8. Arrange in order steps in pesticide selection.
9. List protective garments worn for pesticide application.
10. Label symptoms of pesticide poisoning.
11. Describe first aid procedures for pesticide poisoning.
12. Select from a list rules for pesticide storage.
13. Identify types of pesticide equipment.
14. Arrange in order steps in cleaning pesticide equipment.
15. Read chemical labels.
16. Match chemicals with correct application methods.

CHEMICAL SAFETY
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

  A. Provide student with objective sheet and make transparencies.

  B. Provide student with information and assignment sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information sheet.

  E. Discuss assignment sheets.

  F. Bring several types of chemicals to the classroom to familiarize students with them.

  G. Discuss chemical mixing; obtain chemical compatibility charts for students.

  H. Bring in safety equipment and demonstrate proper use.

  I. Discuss safety procedures for chemical use and storage.

  J. Demonstrate proper mixing procedures for various types of chemicals.

  K. Discuss first aid for chemical injuries.

  L. Give test.

  M. Reteach if necessary.

II. Instructional materials:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1-Acute Toxicity Measures and Warnings

    2. TM 2--Safety Equipment

  D. Assignment sheets

    1. Assignment Sheet #1-Read Chemical Labels

    2. Assignment Sheet #2-Match Chemicals With Correct Application Methods

  E. Test

  F. Answers to test

III. Unit references:

A. Richardson, William B., and Moore, Gary E. *Working in Horticulture.* New York: Gregg Division/McGraw-Hill Book Company, 1980.

B. Nesheim, O. Norman. *Safe Use of Pesticides in the Home and Garden.* OSU Extension Facts No. 7459. Stillwater: Oklahoma State University, n.d.

C. Nesheim, O. Norman. *Check Your Pesticide Labels.* OSU Extension Facts No. 8454. Stillwater: Oklahoma State University, n.d.

D. Nesheim, O. Norman, and Criswell, Jim T. *Toxicity of Pesticides.* OSU Extension Facts No. 7457. Stillwater: Oklahoma State University, n.d.

E. Colvin, Thomas A., and Turner, J. Howard. *Applying Pesticides.* Athens, GA: American Association for Vocational Instructional Materials, 1976.

CHEMICAL SAFETY
UNIT I

INFORMATION SHEET

I. Terms and definitions

  A. General pesticide--Pesticide not likely to harm humans and the environment when used as directed

  B. Restricted pesticide--Pesticide which poses a threat to humans or the environment, even when used as directed

  (NOTE: With this type of pesticide, the user must pass tests to be a certified applicator.)

  C. Selective pesticide--Kills some pests while not affecting others

  D. Nonselective pesticide--Kills all pests

  E. LD_{50}--Measure of acute oral and dermal toxicity; the average lethal dose per unit of body weight required to kill 50% of a large test population (mg/kg)

  Example: Temik has an LD_{50} of 5. This means it takes 5 mg per kg. of body weight to kill 50% of the test population

  F. LC_{50}--Measure of acute inhalation toxicity; the average lethal concentration inhaled per unit of air (mg/L)

II. Classifications of pesticides

  A. Insecticide--Destroys or protects against insects

  B. Fungicide--Destroys or protects against fungi

  C. Bactericide--Destroys or protects against bacteria

  D. Herbicide--Selective or nonselective material for killing weeds or preventing weed seed germination

  E. Nematicide--Destroys nematodes

  F. Miticide--Destroys mites

  G. Acaricide--Destroys or repels spiders, mites, and ticks

  H. Avicide--Kills birds which may harm or destroy crops

  I. Rodenticide--Kills small rodents which may feed on crops or seeds

III. Ways pesticides work

  A. Stomach poison--Kills when swallowed

  B. Contact poison--Kills when in contact with pest

  C. Fumigant--Kills when inhaled or absorbed

INFORMATION SHEET

- D. Translocated herbicide--Kills plants when absorbed by any part of the plant
- E. Systemic--Kills pest when introduced into system of the host, without damaging the host
- F. Protectant--Prevents pest entry or damage; may also be known as a repellant
- G. Sterilant--Keeps pests from reproducing
- H. Defoliant and dessicant--Causes plants to lose foliage

IV. Toxicity of pesticides

(NOTE: Acute toxicity is measured by LD_{50} or LC_{50}; chronic toxicity does not have a standard measure.)

- A. Acute toxicity--Measures how poisonous a chemical is after one exposure

  (NOTE: This may be measured by oral LD_{50}, dermal LD_{50}, or inhalation LC_{50}. See Transparency 1.)

- B. Chronic or cumulative toxicity--Measures how poisonous a chemical is after repeated small doses

  (NOTE: This may be measured as oral, dermal or inhalation toxicity.)

V. Forms of pesticides

- A. Liquid
  1. Emulsifiable concentrate (EC)--Mixed with water
  2. Solution (S)--Does not require mixing with water
  3. Flowable (F)--Thick liquid mixed with water to form a suspension
  4. Aerosol (A)--Low concentrate solution applied by sprayer, fogger or pressurized can
  5. Fumigant--Most often packaged in pressurized cans; turns to gas when applied
- B. Dry
  1. Dust (D)--Active ingredient is added to a fine powder and used dry
  2. Granules (G)--Particles are much larger than dust and used dry
  3. Wettable power (WP or W)--Dust is mixed with water; must have constant agitation to remain in suspension

INFORMATION SHEET

4. Soluble powder (SP)–Powder which dissolves easily in water

5. Bait--Granules, tablets, or some other form of pesticide mixed with an edible bait

VI. Information on a pesticide label (Transparency 1)

A. Trade or brand name

B. Common name

C. Chemical name

D. Ingredient statement

E. Net contents

F. Name and address of manufacturer

G. Registration and establishment numbers

H. Use classification

I. Directions for use

J. Precautionary statement

K. Signal words and symbols

L. Statement of practical treatment

M. Physical or chemical hazards

N. Reentry statement

O. Storage and disposal directions

P. Category of applicator

(NOTE: Use of some chemicals is restricted; category of applicator may be listed on the label.)

VII. Precautions for chemical safety

A. Follow all directions on the label

B. Avoid spraying outdoors on windy days

C. Spray chemicals away from animals and humans

D. Do not apply chemicals near water sources or rainfall or irrigation runoff

INFORMATION SHEET

E. Check label for reentry and harvest regulations

F. Mix chemicals in a well-ventilated area

G. When opening containers, keep face to one side of the cap or lid to avoid contact

H. Use the proper amount of chemical

I. Do not mix chemicals unless allowed by label directions

J. Keep records of all injuries

K. Provide proper storage

VIII. Steps in pesticide selection

A. Identify pest

B. Determine control methods

C. Determine control cost and compare with level of damage

D. Compare application methods

E. Select a pesticide that is effective but is the least hazardous

(NOTE: Use only those pesticides recommended for the pest present.)

IX. Protective garments worn for pesticide application (Transparency 2)

(NOTE: Directions on the label will specify protective clothing required. The more toxic the chemical, the more protection required.)

A. Overalls or long-sleeved shirt and long pants

(NOTE: Pants should be worn outside the boots and fastened with rubber bands.)

B. Raincoat or waterproof apron

C. Hard hat or waterproof hat

D. Boots of unlined neoprene

E. Gloves of unlined neoprene

(NOTE: Gloves should be long enough to protect wrist area, and cuffs should be worn outside gloves.)

F. Goggles or face shield

G. Respirator

(NOTE: Respirators should be approved by Mining Enforcement and Safety Administration [MESA] or National Institute for Occupational Safety and Health [NIOSH].)

INFORMATION SHEET

X. Symptoms of pesticide poisoning

A. Mild poisoning--Irritation of the skin, nose, throat, and eyes; weakness, dizziness, headache, nausea, diarrhea

B. Moderate poisoning--Difficult breathing, blurred vision, rapid pulse, flushed skin, stomach cramps, vomiting, muscle twitches, poor muscle coordination, constricted pupils

C. Severe poisoning--Convulsions, loss of consciousness, secretions from nose and mouth, inability to breathe, often accompanied by fever: MAY BE FATAL

XI. First aid procedures for pesticide poisoning

(CAUTION: ALWAYS GET MEDICAL HELP AS SOON AS POSSIBLE: take the pesticide label with you for the physician to speed treatment.)

A. Chemicals on the skin--Remove clothing and shoes; wash skin and hair with soap and plenty of water; call physician

B. Swallowed chemicals--Check label to see if vomiting should be induced; the throat may swell, so get medical help as soon as possible

C. Chemicals in the eyes--Flush with low-pressure running water for at least fifteen minutes; call physician

D. Inhaled chemicals--Move to area with fresh air; have the person lie down; loosen clothing and keep warm and quiet; get medical help as soon as possible

(NOTE: Have Poison Control Center phone number posted where easily seen and supply school nurse with number.)

XII. Rules for pesticide storage

A. Store chemicals in original containers

B. Store chemicals in safe, dry area

C. Store chemicals in well-ventilated area

D. Keep chemicals labeled and sealed

E. Store all chemicals out of reach of children and animals

F. Never store chemicals near food (animal or human), medicine, or cleaning supplies

G. Dispose of leaking containers and old chemicals

(NOTE: Container disposal must be carried out according to specific label directions.)

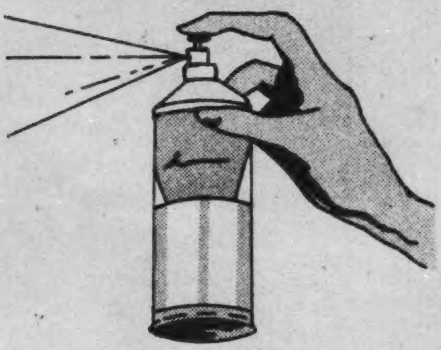
H. Vent hazardous chemical storage cabinets to the outside

INFORMATION SHEET

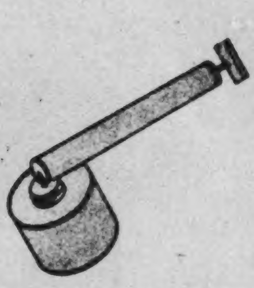
XIII. Types of pesticide equipment

A. Manually operated sprayers

1. Aerosol



2. Hand pump



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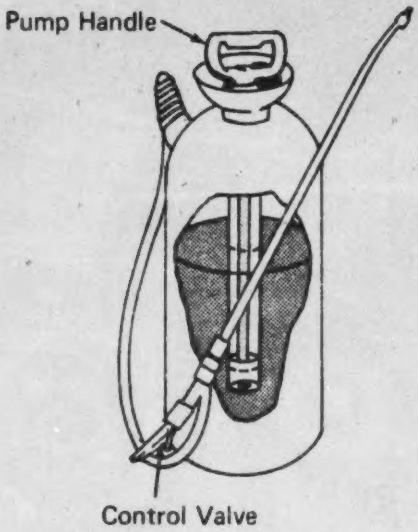
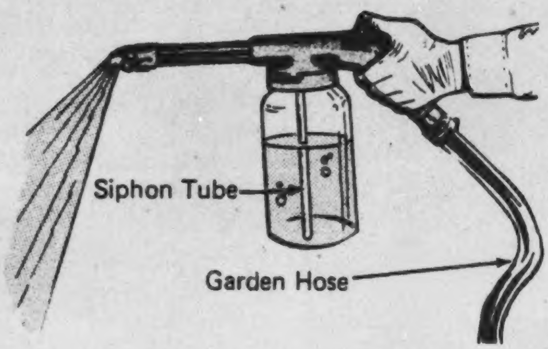
3. Compressed air


Pump Handle
Control Valve

4. Garden hose


Siphon Tube
Garden Hose

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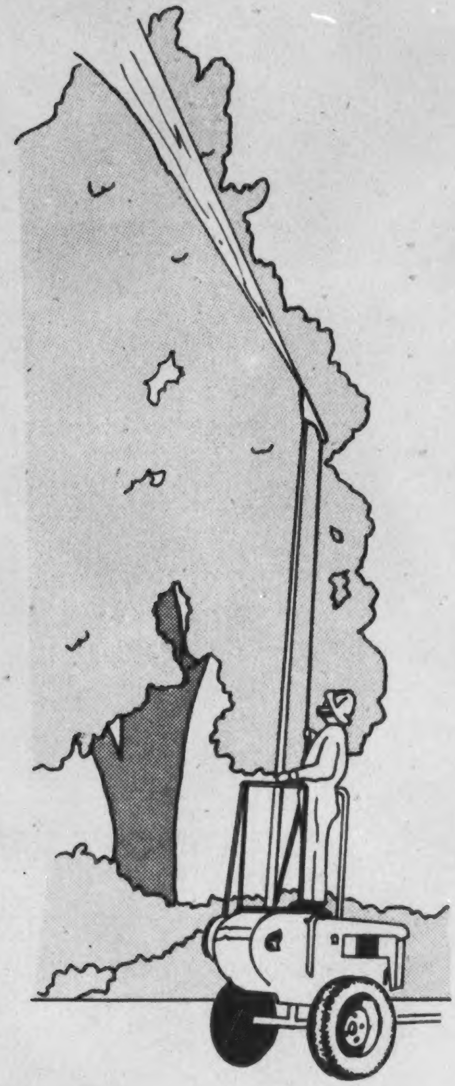
INFORMATION SHEET

B. Power-driven sprayers

1. High pressure



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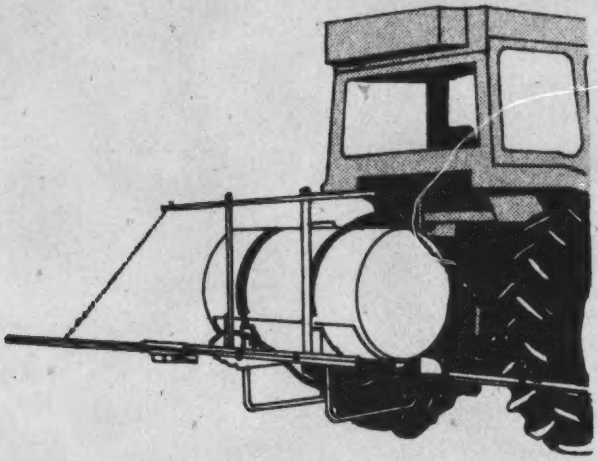
INFORMATION SHEET

2. Low pressure (boom)



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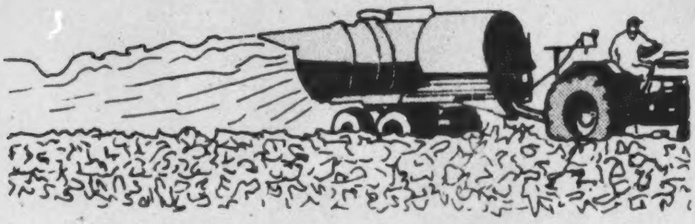
3. Air blast



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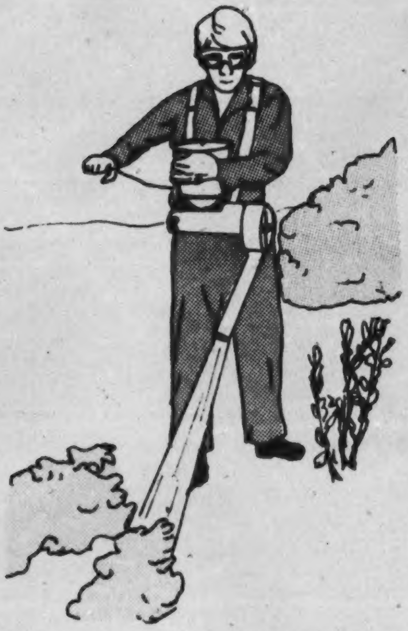
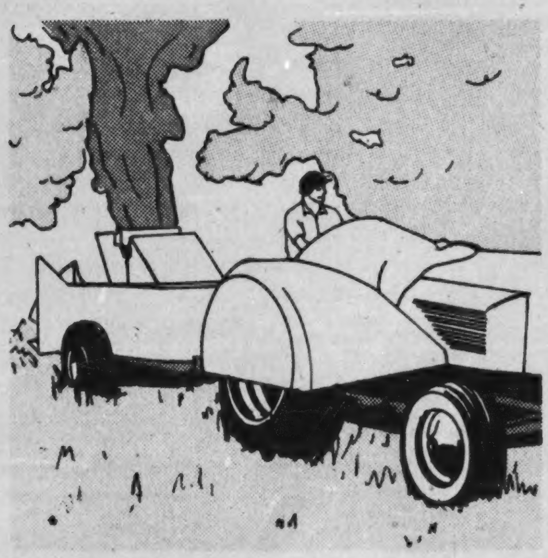
INFORMATION SHEET

C. Dusters

1. Hand duster



2. Power duster



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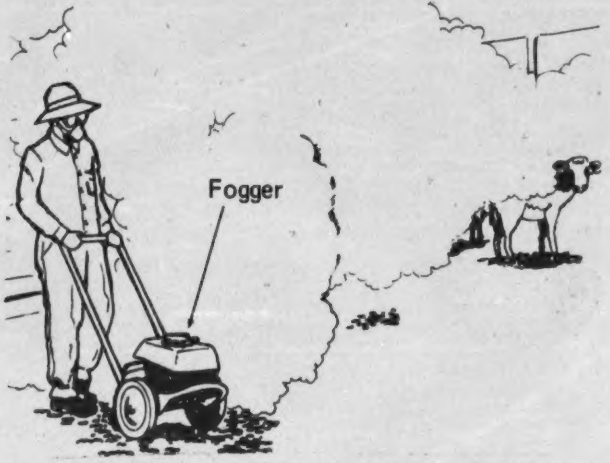
D. Foggers



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INFORMATION SHEET

XIV. Steps in cleaning pesticide equipment

A. Wear protective clothing

B. Check label for specific directions

C. Find a safe place for cleaning

(CAUTION: Find a place where chemical residue will not harm people, animals, or environment.)

D. Drain equipment

(NOTE: Chemical should be collected and disposed of as directed on label.)

E. Remove nozzles, if sprayer type, and clean

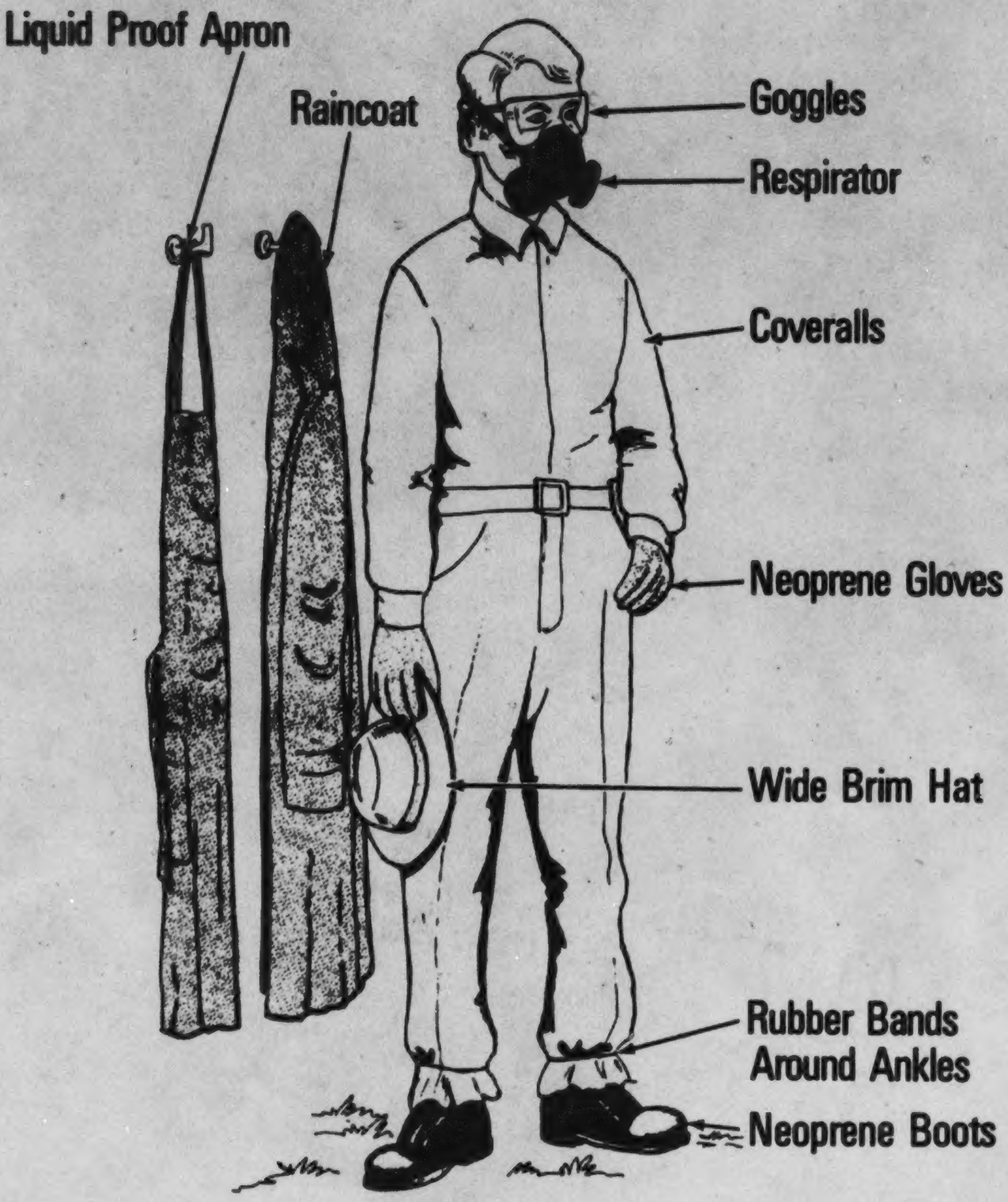
F. Flush system

(NOTE: Special care should be taken when cleaning equipment containing 2,4-D as there are two forms used and they differ in cleaning methods.)

Acute Toxicity Measures and Warnings

Category	Signal Word	LD_{50} Oral mg/kg	LD_{50} Dermal mg/L	LC_{50} Inhalation mg/L
Highly Toxic	DANGER POISON Skull & Crossbones	0–50	0–200	0–2,000
Moderately Toxic	WARNING	50–500	200–2,000	2,000–20,000
Slightly Toxic	CAUTION	500–5,000	2,000–20,000	–
Relatively Non-toxic	CAUTION	5,000+	20,000+	–

Safety Equipment


Liquid Proof Apron
Raincoat
Goggles
Respirator
Coveralls
Neoprene Gloves
Wide Brim Hat
Rubber Bands Around Ankles
Neoprene Boots

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CHEMICAL SAFETY
UNIT I

ASSIGNMENT SHEET #1--READ CHEMICAL LABELS

NAME________________________________ SCORE __________

As a horticulturist, it is important for you to be able to understand the chemicals you will work with.

Using chemicals provided by your instructor, fill in the chart on the next page.

ASSIGNMENT SHEET #1

	Chemical #1	#2	#3
1. Trade or brand name			
2. Common name			
3. Chemical name			
4. Ingredient statement			
5. Net contents			
6. Name and address of manufacturer			
7. Registration and establishment number			
8. Use classification			
9. Directions for use			
10. Precautionary statement			
11. Signal words and symbols			
12. Statement of practical treatment			
13. Hazards to the environment and humans			
14. Physical or chemical hazards			
15. Reentry statement			
16. Storage and disposal directions			
17. Category of applicator			

CHEMICAL SAFETY
UNIT I

ASSIGNMENT SHEET #2--MATCH CHEMICALS WITH CORRECT APPLICATION METHODS

Name____ SCORE ________

Select ten different chemicals at a garden center or nursery and record the following information for each.

	CHEMICAL TRADE NAME	COMMON NAME	APPLICATION METHOD
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

CHEMICAL SAFETY
UNIT I

TEST

NAME______________________________ SCORE ________

1. Match terms associated with pesticides to the correct defintions. Write the correct numbers in the blanks provided.

_____a. Kills some pests while not affecting others

_____b. Measure of acute oral and dermal toxicity; the average lethal dose per unit of body weight required to kill 50% of a large test population (mg/kg)

_____c. Pesticide not likely to harm humans and the environment when used as directed

_____d. Measure of acute inhalation toxicity; the average lethal concentration inhaled per unit of air (mg/L)

_____e. Kills all pests

_____f. Pesticide which poses a threat to humans or the environment, even when used as directed

1. LD_{50}
2. Restricted pesticide
3. Selective pesticide
4. Nonselective pesticide
5. LC_{50}
6. General pesticide

2. Match classifications of pesticides to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Destroys or protects against insects

_____b. Destroys mites

_____c. Destroys nematodes

_____d. Destroys or protects against fungi

_____e. Kills small rodents which may feed on crops or seeds

_____f. Destroys or protects against bacteria

_____g. Selective or nonselective material for killing weeds or preventing weed seed germination

_____h. Kills birds which may harm or destroy crops

_____i. Destroys or repels spiders, mites, and ticks

1. Herbicide
2. Insecticide
3. Bactericide
4. Acaricide
5. Avicide
6. Nematicide
7. Miticide
8. Rodenticide
9. Fungicide

3. Match ways pesticides work to the correct descriptions. Write the correct numbers in the blanks provided.

______a. Prevents pest entry or damage; may also be known as a repellant

______b. Keeps pests from reproducing

______c. Kills when swallowed

______d. Kills when inhaled or absorbed

______e. Kills plants when absorbed by any part of the plant

______f. Causes plants to lose foliage

______g. Kills pest when introduced into system of the host, without damaging the host

______h. Kills when in contact with pest

1. Stomach poison
2. Fumigant
3. Contact poison
4. Systemic
5. Protectant
6. Sterilant
7. Translocated herbicide
8. Defoliant and dessicant

4. Compare toxicity of pesticides.

a. Acute toxicity-- ____

____

____

____

b. Chronic or cumulative toxicity-- ____________________________

____

____

____

5. Select from the following list forms of pesticides. Mark liquids with an "L" and dry pesticides with a "D."

______a. Dust (D) active ingredient is added to a fine powder and used dry

______b. Soluble powder (SP) powder which dissolves easily in water

______c. Fumigant--Most often packaged in pressurized cans; turns to gas when applied

______d. Aerosol (A)--Low concentrate solution applied by sprayer, fogger, or pressurized can

______e. Wettable powder (WP or W)--Dust is mixed with water; must have constant agitation to remain in suspension _____f. Granules (G) particles are much larger than dust and used dry

_____g. Flowable (F) thick liquid mixed with water to form a suspension

_____h. Emulsifiable concentrate (EC) mixed with water

_____i. Bait--Granules, tablets, or some other form of pesticide mixed with an edible bait

_____j. Solution (S) does not require mixing with water

6. Match pesticide information to the sample pesticide label shown on the next pages. Write the correct names in the blanks provided.

Ingredient statement

Net contents

Name and address of manufacturer

Resistration and establishment numbers

Use classification

Directions for use

Precautionary statement

Signal words and symbols

Trade or brand name

Common name

Chemical name

Re-entry statement

Storage and disposal directions

Physical or chemical hazards

Statement of practical treatment

HORT - 27-F

D•z•n®

a. ____________________

Active Ingredients:
O, O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate....... 48%

b. ____________________

Five Gallons

U.S. Standard Measure

c. ____________________

Warning

See additional warning statements left of container seam.

d. ____________________

EPA Est. 100-AL-1
EPA Reg. No. 100-461
Control No. 52200

See directions for use on panel at right.

e. ____________________

Insecticide

For control of certain insects on fruits, nuts, vegetables, field crops, and ornamentals

f. ____________________

Sample label used with permission of CIBA-GEIGY Corporation

28-F

Diazinon® AG500

g. ______________________________

Active Ingredients:	
O, O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate	**48%**
Xylene	**36%**
Inert Ingredients:	**16%**
Total:	**100%**

h. ______________________________

Directions for Use

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Fruit and Nut Crops

Note: Unless otherwise stated, the following rates should be applied as a dilute full cover spray.

Almonds
Mites, Twig Borers: Apply 1 - 1½ pts. per 100 gals. of water.

Parlatoria Scales, San Jose Scales: Mix 1-1½ pts. D•z•n Diazinon AG500 plus 2-3 gals. dormant oil per 100 gals. of water and apply as a dormant spray.

Almond hulls may be used for feed for livestock.

i. ______________________________

Note: The California Department of Agriculture has set a 5-day reentry for Diazinon on citrus, grapes, peaches, and nectarines. Five days should elapse between the time of application and the time a worker may enter the field to engage in any activity requiring substantial contact with treated foliage. When a mixture of two or more organic phosphate pesticides is applied, the interval shall be prolonged by adding to the longest applicable interval an additional 50% of that interval.

j. ______________________________

Statement of Practical Treatment

If swallowed, call a physician immediately. DO NOT INDUCE VOMITING UNLESS NO OTHER TREATMENT IS AVAILABLE. Vomiting may cause aspiration pneumonia. If it is necessary to induce vomiting, give victim one or two glasses of water and insert finger in back of throat. Repeat until vomit fluid is clear. Do not induce vomiting or give anything by mouth to an unconscious person.

If inhaled, remove victim to fresh air and apply artificial respiration if indicated.

If on skin, wash promptly with soap and water. Rinse thoroughly.

If in eyes, rinse eyes for at least 15 minutes with water and call a physician immediately.

Note to Physician: Gastric lavage is indicated. Atropine sulfate and 2-PAM are specific antidotes.

Environmental Hazards

This product is toxic to fish, birds, and other wildlife. Birds feeding on treated areas may be killed. Keep out of lakes, streams, ponds, tidal marshes, and estuaries (except for effluence from treated watercress beds). Do not apply to water that will be used for recreational purposes and human and livestock consumption. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where fish, shrimp, crab, and other aquatic life are important resources. This product must not be used in areas where impact on threatened endangered species is likely. Contact your State Fish and Game Agency for information pertaining to areas having threatened endangered species. Apply this product only as specified on this label.

This pesticide is highly toxic to bees exposed to direct treatment or to residues remaining on the treated area. Do not apply when bees are actively visiting the crop, cover crop, or weeds blooming in the treatment area. Applications should be timed to provide the maximum possible interval between treatment and the next period of bee activity.

k. ______________________________

Physical or Chemical Hazards

Do not use, pour, spill, or store near heat or open flame.

l. ______________________________

Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Pesticide, spray mixture, or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or buried in a safe place away from water supplies. Reseal container and offer for reconditioning, or triple rinse (or equivalent) and offer for recycling, reconditioning, or disposal in approved landfill, or bury in a safe place. Consult federal, state, or local disposal authorities for approved alternative procedures.

m. ______________________________

Precautionary Statements

Hazards to Humans and Domestic Animals

WARNING

May be fatal if swallowed. May be absorbed through skin. Do not breathe spray mist. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. Avoid contamination of food. Do not use on humans or permit children to go onto sprayed grass until spray has completely dried.

Keep out of reach of domestic animals. Do not contaminate feed or use on household pets or livestock. Do not permit pets to go onto sprayed grass until spray has completely dried.

n. ______________________________

Agricultural Division
CIBA-GEIGY Corporation
Greensboro, NC 27409
CGA 1L83C 060

o. ______________________________

7. Select from the list below precautions for chemical safety. Mark each correct answer with an "X."

_____a. Follow all directions on the label

_____b. Apply chemicals near irrigation runoff to allow quick removal of the excess chemical

_____c. Use a bit more chemical than recommended to be sure it is effective

_____d. When opening containers, keep face to one side of the cap or lid to avoid contact

_____e. Spray on windy days to help excess material leave the area quickly

_____f. Mix chemicals in a well-ventilated area

_____g. Record serious injuries; minor injuries are unimportant

8. Arrange in order the steps in pesticide selection. Write a "1" for the first step, a "2" for the second step, and so on.

_____a. Compare application methods

_____b. Identify pest

_____c. Select a pesticide that is effective but is the least hazardous

_____d. Determine control cost and compare with level of damage

_____e. Determine control methods

9. List protective garments worn for pesticide application.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

10. Label symptoms of pesticide poisoning according to their degree of poisoning.

a. ____________________ Irritation of the skin, nose, throat, and eyes; weakness, dizziness, headache, nausea, diarrhea

b. ____________________ Convulsions, loss of consciousness, secretions from nose and mouth, inability to breathe, often accompanied by fever; MAY BE FATAL

c. ____________________ Difficult breathing, blurred vision, rapid pulse, flushed skin, stomach cramps, vomiting, muscle twitches, poor muscle coordination, constricted pupils

11. Describe first aid procedures for pesticide poisoning in the blanks provided.

a. Swallowed chemicals-- ____

____

____

____

____

b. Inhaled chemicals-- ____

____

____

____

c. Chemicals in the eyes-- ____

____

____

____

d. Chemicals on the skin-- ____

____

____

____

12. Select from the list below rules for pesticide storage. Mark each correct answer with an "X."

_____a. Keep chemicals labeled and sealed

_____b. After partial use, transfer remaining chemicals to a smaller container

_____c. Store chemicals in a moist area

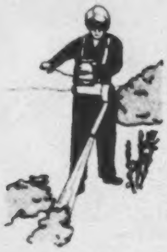
_____d. Dispose of leaking containers and old chemicals

_____e. Store all chemicals out of reach of children and animals

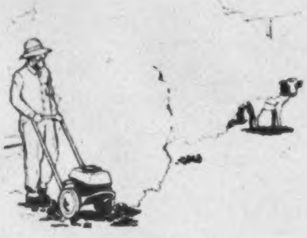
_____f. Vent hazardous chemical storage cabinets to the inside to prevent pollution of the air

13. Identify types of pesticide equipment illustrated below. Write the correct names in the blanks.

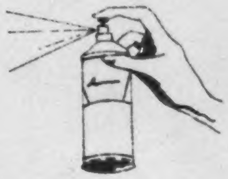
Compressed air sprayer
Garden hose
Air blast sprayer
Hand duster
Hand pump
High pressure sprayer
Low pressure sprayer
Fogger
Aerosol
Power duster



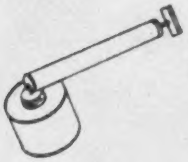
a. __________



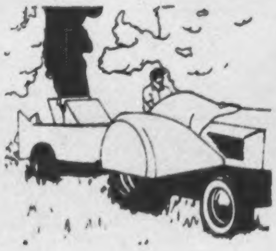
b. __________



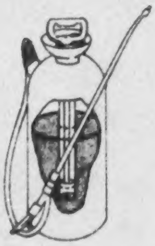
c. __________



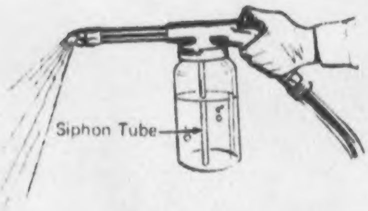
d. __________



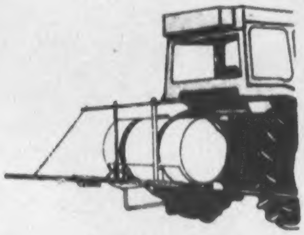
e. __________



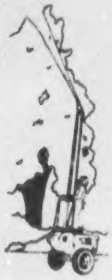
f. __________



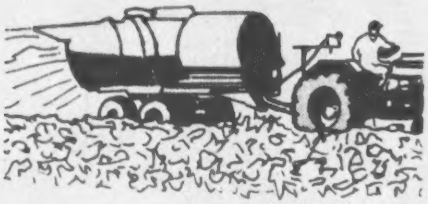
g. __________



h. __________



i. __________



j. __________

14. Arrange in order steps in cleaning pesticide equipment. Write a "1" for the first step, a "2" for the second step, and so on through step 6.

_____a. Drain equipment

_____b. Find a safe place for cleaning

_____c. Remove nozzles, if sprayer type, and clean

_____d. Flush system

_____e. Wear protective clothing

_____f. Check label for specific directions

15. Read chemical labels.

16. Match chemicals with correct application methods.

(NOTE: If activities 15 and 16 have not been finished before the test, ask your instructor when they should be completed.)

CHEMICAL SAFETY
UNIT I

ANSWERS TO TEST

1. a. 3
    b. 1
    c. 6
    d. 5
    e. 4
    f. 2
2. a. 2
    b. 7
    c. 6
    d. 9
    e. 8
    f. 3
    g. 1
    h. 5
    i. 4
3. a. 5
    b. 6
    c. 1
    d. 2
    e. 7
    f. 8
    g. 4
    h. 3
4. a. Acute toxicity--Measures how poisonous a chemical is after one exposure
    b. Chronic or cumulative toxicity--Measures how poisonous a chemical is after repeated small doses
5. a. D
    b. D
    c. L
    d. L
    e. D
    f. D
    g. L
    h. L
    i. D
    j. L
6. a. Trade or brand name
    b. Chemical name
    c. Net contents
    d. Signal words and symbols
    e. Registration and establishment numbers
    f. Use classification

- g. Common name
- h. Ingredient statement
- i. Directions for use
- j. Re-entry statement
- k. Statement of practical treatment
- l. Physical or chemical hazards
- m. Storage and disposal directions
- n. Precautionary statement
- o. Name and address of manufacturer

7. a, d, f

8. a. 4 d. 3
   b. 1 e. 2
   c. 5

9. a. Overalls or long-sleeved shirt and long pants
   b. Hard hat or waterproof hat
   c. Gloves of unlined neoprene
   d. Boots of unlined neoprene
   e. Goggles or face shield
   f. Respirator
   g. Raincoat or waterproof apron

10. a. Mild poisoning
    b. Severe poisoning
    c. Moderate poisoning

11. a. Swallowed chemicals--Check label to see if vomiting should be induced; the throat may swell, so get medical help as soon as possible
    b. Inhaled chemicals--Move to area with fresh air; have the person lie down; loosen clothing and keep warm and quiet; get medical help as soon as possible
    c. Chemicals in the eyes--Flush with low-pressure running water for at least 15 minutes; call physician

   d. Chemicals on the skin–Remove clothing and shoes; wash skin and hair with soap and plenty of water; call physician

12. a, d, e

13. a. Hand duster
    b. Fogger
    c. Aerosol
    d. Hand pump
    e. Power duster
    f. Compressed air
    g. Garden hose
    h. Low pressure (boom) sprayer
    i. High pressure sprayer
    j. Air blast

14. a. 4
    b. 3
    c. 5
    d. 6
    e. 1
    f. 2

15. Evaluated to satisfaction of instructor

16. Evaluated to satisfaction of instructor

PLANT DISEASE CONTROL
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to diagnose general groups of plant diseases and recommend treatments for their control. This knowledge will be evidenced by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. List the causes of plant diseases.
2. Match characteristics of disease-causing microorganisms to the correct descriptions.
3. Select from a list methods of disease transmission.
4. Complete a chart of common horticultural diseases and their control methods.
5. Diagnose common plant diseases.
6. Identify common plant diseases.

PLANT DISEASE CONTROL
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and assignment sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Visit greenhouse and nursery operations and discuss disease problems and control methods with the management.

   F. Bring in plants with various diseases to aid students in identification.

   G. Obtain disease slide sets from Clemson University and Ohio State University Curriculum laboratories

      1. 10 Tillman Hall
         Clemson University
         Clemson, SC 29631

      2. The National Center for Research in Vocational Education
         960 Kenny Road
         The Ohio State University
         Columbus, OH 43210

   H. Give test.

   I. Reteach if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Assignment sheets

      1. Assignment Sheet #1--Diagnose Common Plant Diseases

      2. Assignment Sheet #2--Identify Common Plant Diseases

   D. Answers to assignment sheets

   E. Test

   F. Answers to test

III. Unit references:

A. Denisen, Ervin L. *Principles of Horticulture.* New York: The Macmillan Company, 1967.

B. Richardson, William B., and Moore, Gary E. *Working in Horticulture.* New York: Gregg Division/McGraw-Hill Book Company, 1980.

PLANT DISEASE CONTROL
UNIT II

INFORMATION SHEET

I. Causes of plant diseases

  A. Bacteria

  B. Viruses

  C. Fungi

  D. Growing environment

  (NOTE: Improper moisture, light, air, nutrients, temperatures, or any combination of these factors can cause plant diseases.)

II. Characteristics of disease-causing microorganisms

  A. Bacteria--Microscopic one-celled living plants which do not contain chlorophyll and cannot manufacture their own food

  (NOTE: Bacteria enter the plant through natural openings and wounds.)

  B. Viruses--Microscopic organisms which reproduce only when in the cells of plants or animals

  C. Fungi--Plants lacking chlorophyll, often large enough to be seen without magnification; contain more than one cell and reproduce sexually (spores) and asexually

III. Methods of disease transmission

  A. Wind

  B. Water

  C. Soil

  D. Insects

  E. Humans

  F. Susceptible plants

  G. Animals

INFORMATION SHEET

IV. Common horticultural diseases

Disease	Characteristics	Common types	Control
Leaf spot	Small or large spots on leaves usually caused by bacteria or fungi; center of spot may fall out; most common in rainy seasons	Black spot on rose, Boston ivy leaf spot, Septoria leaf spot	Remove infected leaves and burn them; use proper spray as recommended
Blight	Rapid deterioration of the plant; leaves may develop spots that spread over the leaf; blossoms and twigs may die (NOTE: There is no one characteristic common to all blights.)	Fire blight on apple and pear, azalea petal blight, lilac phytophthora	Spray with recommended chemical *before* infestation; Select resistant varieties
Rots	Death and decay of plant parts; parts turn brown and soggy and often smell bad. Can affect buds, stems, fruits, roots, and bulbs	Root rot, Canna bud rot, Peach tree brown rot	Remove rotten parts; proper watering; preventive spraying
Rusts	Fungus disease causing small orange, yellow, red, brown, or white spots that often resemble rust. Found on top or bottom of leaves and stems; release spores (NOTE: Some rusts require alternate hosts.)	Cedar-apple rust (alternate host type), carnation rust, green bean rust, asparagus rust	Maintain good ventilation; avoid water on leaves; remove infected parts. Do not plant noncrop hosts in the same area
Smuts	Blister-like lesions develop on flowers, leaves and stems, eventually bursting and releasing spores. Plant may be deformed.	Corn smut, smut on onion, Bermuda grass, carnations, violets	Good sanitation; burn infected parts since spores can survive in the soil 6 or 7 years.
Mildew	Fungus disease that grows on the surfaces of plants; forms white or gray splotches that are soft to the touch; develops best in humid weather, warm days, and cold nights.	Powdery mildew and downy mildew on grapes, lilac, apples, roses, chrysanthemums, turfgrasses	Good air circulation; several chemical sprays are available.

INFORMATION SHEET

Disease	Characteristics	Common types	Control
Wilt	Entire plant wilts and has been properly watered. If the stem is sliced, brown streaks appear where the water-conducting tissue has been blocked. Caused by fungi, bacteria, or viruses	Fusarium wilt on carnation, okra, celery, melons, tomato	Use sterile soil; eliminate diseased plants
Gall	Large tumorlike growths found on roots, stems and/or leaves; caused by insects, bacteria, or fungi; may appear white or pink and fluffy when found on leaves	Crown gall on fruit trees, azalea leaf gall	Plant resistant varieties; remove infected leaves
Damping-off	Young seedlings suddenly die shortly after germination; often soil is too wet; caused by a fungus which weakens stems, causing them to fall over	Common to all types of seedlings	Avoid overwatering; use sterile soil; use chemically treated seed

(NOTE: Generally, disease control is preventive rather than curative. Always check to see if resistant varieties are available.)

PLANT DISEASE CONTROL
UNIT II

ASSIGNMENT SHEET #1--DIAGNOSE COMMON PLANT DISEASES

NAME ______________________ SCORE __________

You will often be called upon to diagnose plant diseases. Read the following cases; then write your diagnosis and the steps you would take to remedy the problem.

1. Your neighbor has a live oak tree that has various sizes of growths on the leaves. They are fuzzy and pale yellow in appearance.

   Problem: ______________________

   Cure: ______________________

2. In the greenhouse you notice some type of disease on your carnations. There are orangeish bumps or pustules on the stems of the carnations.

   Problem: ______________________

   Cure: ______________________

3. While walking through the yard, you spot some zinnias that appear unhealthy. Upon closer inspection, you see a white coating on the surfaces of the leaves.

   Problem: ______________________

   Cure: ______________________

4. Your instructor seeded a flat of tomatoes last week. Germination was good but suddenly many of the plants simply fall over and die.

   Problem: ______________________

   Cure: ______________________

5. The okra plants in your garden have grown well for the past month. Then they begin to wilt, even though they have adequate water. When you slice the stem lengthwise, brown streaks appear.

   Problem: ______________________

   Cure: ______________________

6. In a roadside ditch you notice some Bermuda grass that looks strange. When you look closer, you see that the seed heads are covered with a black, fluffy material.

   Problem: ______________________

   Cure: ______________________

ASSIGNMENT SHEET #1

7. Your begonia has developed irregular brown spots on the leaves. The growing tip and some stems have blackened. When you knock the plant out of the pot, the roots are thin and brown.

Problem: ______________________________

Cure: ______________________________

8. The apple tree next door has begun to display brown leaves. The tips of the stems are crooked down and the leaves look like they have been burned.

Problem: ______________________________

Cure: ______________________________

9. Your hybrid tea rose has some strange disease. Black spots are all over the leaves.

Problem: ______________________________

Cure: ______________________________

PLANT DISEASE CONTROL
UNIT II

ASSIGNMENT SHEET #2–IDENTIFY COMMON PLANT DISEASES

NAME ______________________________ SCORE ______________

Identify common plant diseases shown to you by your instructor. Fill out the chart below.

Disease	Host	Location	Treatment
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PLANT DISEASE CONTROL
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. Galls

   Remove infected leaves; select resistant varieties

2. Rust

   Maintain good ventilation; avoid water on the leaves; remove infected parts

3. Mildew

   Increase air circulation; spray with proper chemical

4. Damping-off

   Avoid overwatering; use sterile soil; use chemically treated seed

5. Wilt

   Sterilize soil; dispose of diseased plants

6. Smut

   Burn infected parts

7. Rot

   Remove rotten parts; water properly

8. Blight

   Spray with recommended chemical; choose resistant varieties

9. Black spot (leaf spot)

   Remove infected leaves and burn them; use proper spray as recommended

PLANT DISEASE CONTROL
UNIT II

TEST

NAME ______________________________ SCORE __________

1. List the causes of plant diseases in the spaces below.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

2. Match characteristics of disease-causing microorganisms to the correct descriptions. Write the correct numbers in the blanks provided.

   _____a. Microscopic organisms which reproduce only when in the cells of plants or animals

   _____b. Plants lacking chlorophyll, often large enough to be seen without magnification; contain more than one cell and reproduce sexually (spores) and asexually

   _____c. Microscopic one-celled living plants which do not contain chlorophyll and cannot manufacture their own food

   1. Viruses
   2. Bacteria
   3. Fungi

3. Select from the list below methods of disease transmission. Mark each correct answer with an "X."

   _____a. Wind

   _____b. Water

   _____c. Temperature

   _____d. Insects

   _____e. Humidity

   _____f. Susceptible plants

   _____g. Humans

   _____h. Natural disasters

   _____i. Soil

   _____j. Animals

4. Complete the chart below of common horticultural diseases. Write the correct information in the blanks provided.

Disease	Characteristics	Common types	Control
Leaf spot	Small or large spots on leaves usually caused by bacteria or fungi; center of spot may fall out; most common in rainy seasons	a.__________ __________ __________	Remove infected leaves and burn them; use proper spray as recommended
Blight	Rapid deterioration of the plant; leaves may develop spots that spread over the leaf; blossoms and twigs may die	Fire blight on apple and pear, azalea petal blight, lilac phytophthora	b.__________ __________ __________
Rots	c.______________ ______________ ______________	Root rot, Canna bud rot, Peach tree brown rot	Remove rotten parts; proper watering; preventive spraying
Rusts	Fungus disease causing small orange, yellow, red, brown, or white spots that often resemble rust. Found on top or bottom of leaves and stems; release spores	Cedar-apple rust (alternate host type) carnation rust, green bean rust, asparagus rust	d.__________ __________ __________ __________
Smuts	e.______________ ______________ ______________	Corn smut, smut on onion, Bermuda grass, carnations, violets	Good sanitation; burn infected parts since spores can survive in the soil 6 or 7 years.
f.__________	Fungus disease that grows on the surfaces of plants; forms white or gray splotches that are soft to the touch; develops best in humid weather, warm days, and cold nights.	Powdery mildew and downy mildew on grapes, lilac, apples, roses, chrysanthemums, turfgrasses	Good air circulation; several forms chemical sprays are available.
Wilt	Entire plant wilts and has been properly watered. If the stem is sliced, brown streaks appear where the water-conducting tissue has been blocked. Caused by fungi, bacteria, or viruses	Fusarium wilt on carnation, okra, celery, melons, tomato	g.__________ __________ __________

Disease	Characteristics	Common types	Control
Gall	Large tumorlike growths found on roots, stems and/or leaves; caused by insects, bacteria, or fungi; may appear white or pink and fluffy when found on leaves	h.__________ __________	Plant resistant varieties; remove infected leaves
i.__________	Young seedlings suddenly die shortly after germination; often soil is too wet; caused by a fungus which weakens stems, causing them to fall over	Common to all types of seedlings	Avoid overwatering; use sterile soil; use chemically treated seed

5. Diagnose common plant diseases.

6. Identify common plant diseases.

   (NOTE: If questions 5 and 6 have not been finished before the test, ask your instructor when they should be completed.)

PLANT DISEASE CONTROL
UNIT II

ANSWERS TO TEST

1. a. Viruses
   b. Bacteria
   c. Fungi
   d. Growing environment
2. a. 1
   b. 3
   c. 2
3. a, b, d, f, g, i, j
4. a. Black spot on rose, Boston ivy leaf spot, Septoria leaf spot
   b. Spray with recommended chemical *before* infestation; select resistant varieties
   c. Death and decay of plant parts; parts turn brown and soggy and often smell bad. Can affect buds, stems, fruits, roots, and bulbs
   d. Maintain good ventilation; avoid water on leaves; remove infected parts. Do not plant noncrop hosts in the same area
   e. Blister-like lesions develop on flowers, leaves and stems, eventually bursting and releasing spores. Plant may be deformed
   f. Mildew
   g. Use sterile soil; eliminate diseased plants
   h. Crown gall on fruit trees, azalea leaf gall
   i. Damping-off
5. Evaluated to satisfaction of instructor
6. Evaluated to satisfaction of instructor

WEED CONTROL
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to demonstrate the ability to apply herbicides safely. This knowledge will be evidenced by completion of the assignment sheet and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVE

After completion of this unit, the student should be able to:

1. Match terms associated with weed control to the correct definitions.
2. List solutions to weed problems.
3. Match classifications of weeds to the correct definitions.
4. List methods of weed control.
5. List ways weeds compete with crops.
6. Match types of chemical treatments to the correct definitions.
7. Name methods of application.
8. List conditions needed for successful weed control.
9. Identify methods of weed control.

WEED CONTROL
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Bring different herbicides to the classroom, or visit a local supplier to allow the students to become more familiar with herbicides.

   F. Bring in common weeds for identification.

   G. Discuss safety procedures for herbicide application.

   H. Give test.

   I. Reteach if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Assignment Sheet #1--Identify Methods of Weed Control

   D. Test

   E. Answers to test

WEED CONTROL
UNIT III

INFORMATION SHEET

I. Terms and definitions

- A. Weed--Any plant growing where it is not wanted
- B. Prevention--Stopping contamination of an area by a specific species
- C. Control--Limiting weed infestation; the most common goal in farm crops
- D. Eradication--Removal of all plants and seeds from a given area
- E. Rhizome--Horizontal underground stem
- F. Stolon--Horizontal stem, usually on the soil surface; runner
- G. Tillage--Mechanical disturbance of the soil
- H. Crop competition--Using the best crop production methods to eliminate weed competition
- I. Crop rotation--Growing a sequence of crops to avoid continuous cropping of a single crop, and the weeds most likely to grow with that crop
- J. Biological control--Use of a natural enemy of a specific weed species to eliminate or control its spread
- K. Fire--Removal of undesirable plants by fire; effective in ditches, roadsides, and certain forest areas; must be repeated often

II. Solutions to weed problems

- A. Prevention
- B. Control
- C. Eradication

  (NOTE: Eradication is not usually economically feasible.)

III. Classifications of weeds

- A. Annuals--Complete the life cycle in less than one year; fairly easy to control, but are persistent pests due to high numbers of seeds and fast growth
  1. Summer annuals--Seeds germinate in spring, plant matures and dies in fall; seeds remain inactive until spring

     Examples: Lambsquarters, goosegrass, ragweed, crabgrass

INFORMATION SHEET

2. Winter annuals--Seeds germinate in fall or winter and plant matures in spring or summer

   Examples: Chickweed, downy brome, henbit, shepherdspurse, cheat

B. Biennials--Plant lives for more than one year, but no more than two years

   Examples: Wild carrot, bull thistle

C. Perennials--Live more than two years; may live indefinitely

1. Simple perennials--Reproduce by seed; do not normally spread vegetatively but cut pieces may produce new plants; roots are normally fleshy

   Examples: Dandelion, dock, plantain, pokeweed

2. Creeping perennials--Reproduce by stolons, rhizomes, or seeds

   Examples: Nutsedge, Johnsongrass, field bindweed, Bermuda grass

IV. Methods of weed control

A. Tillage

B. Mowing

C. Pulling

D. Crop competition

E. Crop rotation

F. Biological

   Example: Insects that feed on certain plants

G. Fire

H. Chemical

I. Mulch

V. Ways weeds compete with crops

A. Light

B. Moisture

C. Nutrients

D. Carbon dioxide

INFORMATION SHEET

VI. Types of chemical treatments

A. Preplanting--Any treatment made before crop is planted

Example: Treflan

B. Preemergence--Any treatment made just before emergence of crop or weed, depending upon the crop grown and the weed problem

Example: Herbicide applied to the soil surface to prevent weed seed germination

C. Postemergence--Any treatment made after emergence of the crop or weed

Example: Application of 2,4-D to corn crop after weed germination

D. Selective herbicide--Chemical effective only on specific plant types

Example: Balan, 2,4-D

E. Nonselective herbicide--Chemical effective on all plants present; may be a soil sterilant

Examples: Roundup, paraquat

VII. Methods of application

A. Broadcast--Uniform application over an entire area

B. Band--Treatment in the crop row only; space between the rows is cultivated normally

C. Spot--Restricted treatment of a specific area; soil sterilants may be used in small areas with perennial weeds

D. Directed spray--Spray is applied directly at or just above the ground line; applied to specific part of plant

(NOTE: Equipment used for herbicides must not be used for any other type of chemicals. Equipment used for 2,4-D should not be used for any other chemical.)

VIII. Conditions needed for successful weed control

A. Correct weed present

B. Correct temperature

C. Correct stage of growth

D. Correct chemical used

E. Correct method of application

WEED CONTROL
UNIT III

ASSIGNMENT SHEET #1--IDENTIFY METHODS OF WEED CONTROL

NAME________________________________ SCORE__________

Since you will be called on for weed control information, it is important that you become familiar with different methods of weed control. Observe at least two methods of weed control practiced in your area. Then fill in the blanks below and on the next page.

Number 1:

A. Method:

B. Location:

C. Crop:

D. Weed problem:

E. Description of method:

____

____

____

F. How often must this method be repeated?

____

____

G. If a chemical is used, list the common name.

____

____

ASSIGNMENT SHEET #1

Number 2:

A. Method:

B. Location:

C. Crop:

D. Weed problem:

E. Description of method:

F. How often must this method be repeated?

G. If a chemical is used, list the common name.

WEED CONTROL
UNIT III

TEST

NAME______________________________ SCORE______________

1. Match terms associated with weed control to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Removal of undesirable plants by fire; effective in ditches, roadsides, and certain forest areas; must be repeated often

_____b. Any plant growing where it is not wanted

_____c. Use of a natural enemy of a specific weed species to eliminate or control its spread

_____d. Stopping contamination of an area by a specific species

_____e. Limiting weed infestation; the most common goal in farm crops

_____f. Growing a sequence of crops to avoid continuous cropping of a single crop, and the weeds most likely to grow with that crop

_____g. Removal of all plants and seeds from a given area

_____h. Horizontal underground stem

_____i. Mechanical disturbance of the soil

_____j. Horizontal stem, usually on the soil surface; runner

1. Weed
2. Prevention
3. Control
4. Eradication
5. Rhizome
6. Stolon
7. Tillage
8. Crop competition
9. Crop rotation
10. Biological control
11. Fire

2. List solutions to weed problems in the spaces below.

a. ______________________________

b. ______________________________

c. ______________________________

3. Match classifications of weeds to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Reproduce by stolons, rhizomes, or seeds

_____b. Live more than two years; may live indefinitely

_____c. Plant lives for more than one year, but no more than two years

_____d. Seeds germinate in fall or winter and plant matures in spring or summer

_____e. Reproduce by seed; do not normally spread vegetatively but cut pieces may produce new plants; roots are normally fleshy

_____f. Seeds germinate in spring, plant matures and dies in fall; seeds remain inactive until spring

_____g. Complete the life cycle in less than one year; fairly easy to control, but are persistent pests due to high numbers of seeds and fast growth

1. Annuals
2. Summer annuals
3. Winter annuals
4. Biennials
5. Perennials
6. Simple perennials
7. Creeping perennials

4. List methods of weed control in the spaces below.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

5. List ways weeds compete with crops.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

6. Match types of chemical treatments to the correct definitions. Write the correct numbers in the blanks provided.

______a. Any treatment made before crop is planted

______b. Any treatment made after emergence of the crop or weed

______c. Any treatment made just before emergence of crop or weed, depending upon the crop grown and the weed problem

______d. Chemical effective only on specific plant types

______e. Chemical effective on all plants present; may be a soil sterilant

1. Preplanting
2. Selective herbicide
3. Nonselective herbicide
4. Preemergence
5. Postemergence

7. Name methods of application. Write the correct names in the blanks provided.

____________________a. Uniform application over an entire area

____________________b. Treatment in the crop row only; space between the rows is cultivated normally

____________________c. Restricted treatment of a specific area; soil sterilants may be used in small areas with perennial weeds

____________________d. Spray is applied directly at or just above the ground line; applied to specific part of plant

8. List conditions needed for successful weed control in the spaces below.

a. ____

b. ____

c. ____

d. ____

e. ____

9. Identify methods of weed control.

(NOTE: If this activity has not been finished before the test, ask your instructor when it should be completed.)

WEED CONTROL
UNIT III

ANSWERS TO TEST

1. a. 11 f. 9
   b. 1 g. 4
   c. 10 h. 5
   d. 2 i. 7
   e. 3 j. 6
2. a. Prevention
   b. Control
   c. Eradication
3. a. 7 e. 6
   b. 5 f. 2
   c. 4 g. 1
   d. 3
4. a. Tillage
   b. Mowing
   c. Pulling
   d. Crop competition
   e. Crop rotation
   f. Biological
   g. Fire
   h. Chemical
   i. Mulch
5. a. Light
   b. Moisture
   c. Nutrients
   d. Carbon dioxide

6. a. 1 d. 2
   b. 5 e. 3
   c. 4

7. a. Broadcast
   b. Band
   c. Spot
   d. Directed spray

8. a. Correct weed present
   b. Correct temperature
   c. Correct stage of growth
   d. Correct chemical used
   e. Correct method of application

9. Evaluated to satisfaction of instructor

PLANT INSECT CONTROL
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify insects and name methods for their control. This knowledge will be evidenced by completion of the assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with insect control to the correct definitions.
2. List types of insect mouth parts.
3. Label stages of an incomplete life cycle.
4. Label stages of a complete life cycle.
5. Match means of insect control to the correct definitions.
6. List rules for selecting an insecticide.
7. Arrange in order steps for insect control.
8. Complete a chart of common insects, their descriptions, and control.
9. Identify common insects.
10. Identify insect pests in the community.

PLANT INSECT CONTROL
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Bring in plants with various insect problems for students to identify with Assignment Sheet #1.

   F. Give test.

   G. Reteach, if necessary.

II. Instructional materials:

   A. Objective sheet

   B. Information sheet

   C. Assignment sheets

      1. Assignment Sheet #1--identify Common Insects

      2. Assignment Sheet #2--Identify Insect Pests in the Community

   D. Test

   E. Answers to test

III. Unit references:

   A. Davidson, Ralph Howard, and Peairs, Leonard Marion. *Insect Pests of Farm, Garden and Orchard.* 6th ed. New York: John Wiley and Sons, Inc., 1966.

   B. Baudendistel, Robert F. *Horticulture: A Basic Awareness.* Reston, VA: Reston Publishing Company, Inc., 1979.

PLANT INSECT CONTROL
UNIT IV

INFORMATION SHEET

I. Terms and definitions

   A. Insect-Organism with six legs and three body sections; usually has wings

   B. Incomplete metamorphosis-Insect life cycle consisting of three stages: egg, nymph, and adult

   C. Nymph--Immature stage of an insect that already resembles the adult in appearance

   D. Complete metamorphosis--Insect life cycle consisting of four stages: egg, larva, pupa, and adult

   E. Larva--Immature stage of an insect that does not resemble the adult; this stage is actively eating and growing

   F. Pupa--Inactive stage of development in complete life cycle

   G. Insecticide--Any substance which kills insects

   H. Leaf axis--Point on the stem where the leaves are attached

II. Types of insect mouth parts

   A. Sucking

      Examples: Spider mites, aphids

   B. Chewing

      Examples: Bagworms, cutworms

   C. Rasping, sucking

      Example: Thrips

III. Incomplete life cycle

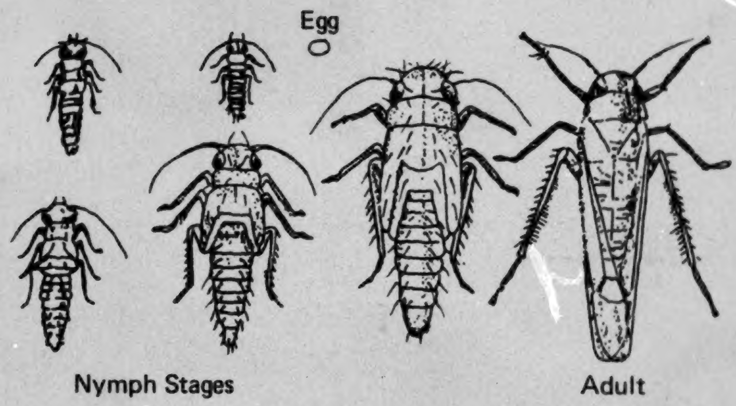
   A. Egg

   B. Nymph

INFORMATION SHEET

C. Adult

Examples: Grasshoppers, leafhoppers



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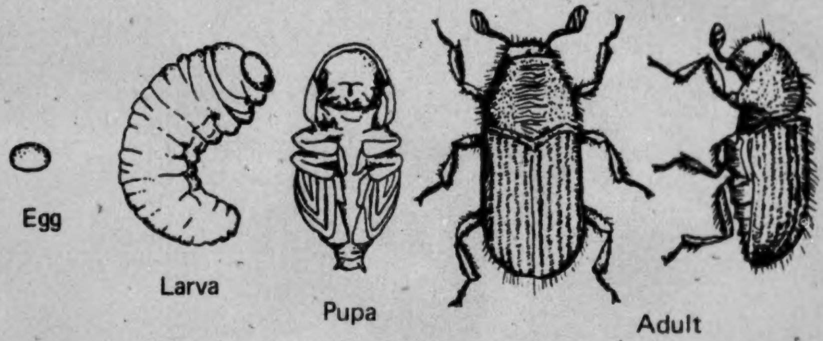
IV. Complete life cycle

A. Egg

B. Larva

C. Pupa

D. Adult



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INFORMATION SHEET

V. Means of insect control

   A. Stomach poison--Kills insect when sprayed on leaves of plant which are then eaten

   B. Contact poison--Insecticide which kills when sprayed on insect

   C. Systemic--Insecticide is applied to soil surface or directly to plant parts and taken up by plant; insects are killed when plant juices or plant parts are eaten

   D. Interruption of life cycle--Chemical is applied to an immature stage of insects to reduce total adult population

   E. Beneficial insects--Insects that do not damage crop, or that prey on harmful insects

      Examples: Ladybug beetles, praying mantis

   F. Radiation of adult males--Sterile male insects are produced by treatment with radiation, making fertilization of eggs impossible

   G. Trap crops--Crop preferred by insects is planted near the desired crop in order to attract the insects away from the desired crop

VI. Rules for selecting an insecticide

   A. Quick and effective

   B. Inexpensive

      (NOTE: Percentage of active ingredient affects cost.)

   C. Safe for plant, humans, and environment

   D. Good coverage

   E. Approved for intended use; **read the label**

VII. Steps for insect control

   A. Determine what insect is present

   B. Select control method

   C. Select insecticide

   D. Mix insecticide at proper rates

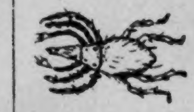
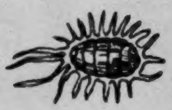
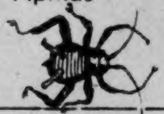
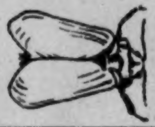
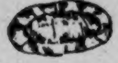
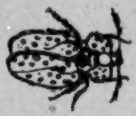
   E. Apply insecticide according to directions

   F. Reapply as necessary

      (NOTE: Integrated pest management is an alternative to use of chemicals only. IPM is a combination of chemical, natural, biological and cultural controls such as varietal selection.)

INFORMATION SHEET

VIII.

Insect	Description	Control
Spider Mites 	Very small insects that cause leaves to turn yellow and create webs on undersides of leaves, new growth, and at the leaf axis; May be red, black, or green. (NOTE: Spider mites are a common pest but are not true insects.)	Syringing with water may be helpful; spray with Kelthane or Diazinon
Mealybugs 	White cottony masses of insects are found at the leaf axis; may leave a sticky residue	For at-home use touch with alcohol-soaked cotton swab; for heavier infestations spray with Diazinon or malathion
Aphids 	Light green, red, black, or brown insects, usually found on flower buds or new growth	Spray with Diazinon, malathion, or Orthene
White flies 	Small, wedge-shaped, winged insect that hides on undersides of leaves and flies when plant is disturbed	Spray with Diazinon or Meta-systox R
Scale 	Many types; one common scale appears as a hard brown disc on leaves or stems	Apply systemic or dormant oil
Lace Bugs 	Lacey-winged insects found on the undersides of leaves where they cause a mottled discoloration	Spray with malathion, Orthene or Sevin

(NOTE: Many insecticides are approved for insect control; read the label for proper insecticide usage and precautions.)

PLANT INSECT CONTROL
UNIT IV

ASSIGNMENT SHEET #1--IDENTIFY COMMON INSECTS

NAME ______________________________ SCORE ______________

As a horticulturist you will need to be able to identify common insect problems. Write the name of the insects provided by your instructor and fill in the chart below.

Type of Insect	Description	Damage	Common Control
1.			
2.			
3.			
4.			
5.			
6.			

PLANT INSECT CONTROL
UNIT IV

ASSIGNMENT SHEET #2--IDENTIFY INSECT PESTS IN THE COMMUNITY

NAME ______________________ SCORE ____________

Take a trip around your community to locate insect pests. Identify at least five, and fill out the chart below.

Type of Insect	Description	Damage	Common Control
1.			
2.			
3.			
4.			
5.			

PLANT INSECT CONTROL
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with insect control to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Any substance which kills insects

_____b. Organism with six legs and three body sections; usually has wings

_____c. Inactive stage of development in complete life cycle

_____d. Insect life cycle consisting of three stages: egg, nymph, and adult

_____e. Immature stage of an insect that does not resemble the adult; this stage is actively eating and growing

_____f. Immature stage of an insect that already resembles the adult in appearance

_____g. Point on the stem where the leaves are attached

_____h. Insect life cycle consisting of four stages: egg, larva, pupa, and adult

1. Insect
2. Complete metamorphosis
3. Insecticide
4. Larva
5. Incomplete metamorphosis
6. Pupa
7. Leaf axis
8. Nymph

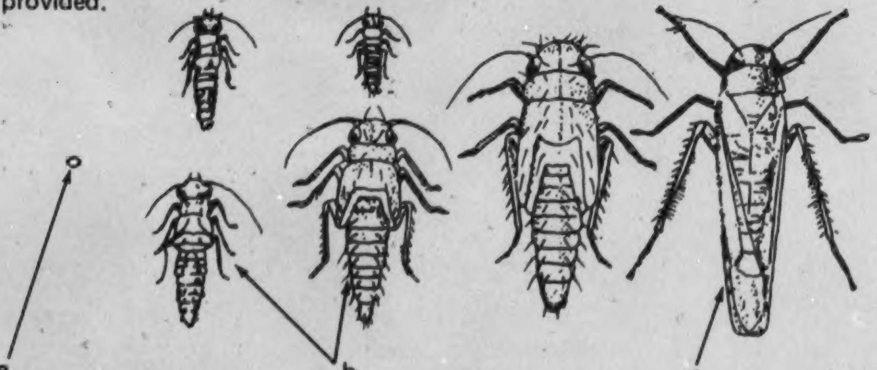
2. List types of insect mouth parts.

a. ____

b. ____

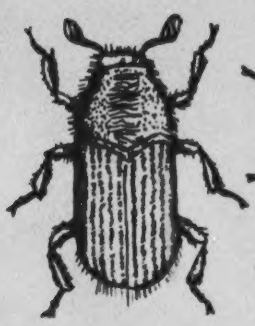
c. ____

3. Label the stages of an incomplete life cycle. Write the correct names in the blanks provided.

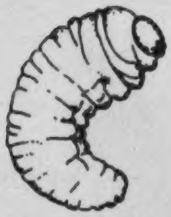


a. ______________ b. ______________ c. ______________

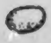
4. Label the stages of a complete life cycle. Write the correct names in the blanks provided.



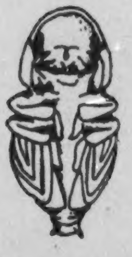
a. ______________________



b. ______________________



c. ______________________



d. ______________________

5. Match means of insect control to the correct definitions. Write the correct names in the blanks provided.

_____a. Crop preferred by insects is planted near the desired crop in order to attract insects away from the desired crop

_____b. Chemical is applied to an immature stage of insects to reduce total adult population

_____c. Insects that do not damage crop, or that prey on harmful insects

_____d. Insecticide which kills when sprayed on insect

_____e. Kills insect when sprayed on leaves of plant which are then eaten

1. Systemic
2. Stomach poison
3. Contact poision
4. Beneficial insects
5. Trap crops
6. Radiation of adult males
7. Interruption of life cycle

_____f. Insecticide is applied to the soil surface or directly to plant parts and taken up by plant; insects are killed when plant juices or plant parts are eaten

_____g. Sterile male insects are produced by treatment with radiation, making fertilization of eggs impossible

6. List rules for selecting an insecticide.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

7. Arrange in order steps for insect control. Write a "1" for the first step, a "2" for the second step, and so on through step 6.

_____a. Mix insecticide at proper rates

_____b. Determine what insect is present

_____c. Reapply as necessary

_____d. Select insecticide

_____e. Apply insecticide according to directions

_____f. Select control method

8. Complete the chart below and on the next page of common insects, their descriptions, and control. Write the correct answers in the blanks provided.

Insect	Description	Control
Spider mites	a.____________________	Syringing with water may be helpful; spray with Kelthane or Diazinon
Mealybugs	White cottony masses of insects are found at the leaf axis; may leave a sticky residue	b.____________________
c.____________________	Light green, red, black, or brown insects, usually found on flower buds or new growth	Spray with Diazinon, malathion, or Orthene

White flies	d. ____________________	Spray with Diazinon or Meta-systox R
Scale	Many types; one common scale appears as a hard brown disc on leaves or stems	e. ____________________
f. ____________________	Lacey-winged insects found on the undersides of leaves where they cause a mottled discoloration	Spray with malathion, Orthene, or Sevin

9. Identify common insects.

10. Identify insect pests in the community.

(NOTE: If activities 9 and 10 have not been finished before the test, ask your instructor when they should be completed.)

PLANT INSECT CONTROL
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 6
   d. 5
   e. 4
   f. 8
   g. 7
   h. 2
2. a. Chewing
   b. Sucking
   c. Rasping, sucking
3. a. Egg
   b. Nymph
   c. Adult
4. a. Adult
   b. Larva
   c. Egg
   d. Pupa
5. a. 5
   b. 7
   c. 4
   d. 3
   e. 2
   f. 1
   g. 6
6. a. Quick and effective
   b. Inexpensive

- c. Safe for plant, humans, and environment
- d. Good coverage
- e. Approved for intended use; **read the label**

7. a. 4
   b. 1
   c. 6
   d. 3
   e. 5
   f. 2

8. a. Very small insects that cause leaves to turn yellow and create webs on undersides of leaves, new growth and at the leaf axis; may be red, black, or green
   b. For at-home use touch with alcohol-soaked cotton swab; for heavier infestations spray with Diazinon or malathion
   c. Aphids
   d. Small wedge-shaped, winged insect that hides on undersides of leaves and flies when plant is disturbed
   e. Apply systemic or dormant oil
   f. Lace bugs

9. Evaluated to satisfaction of instructor

10. Evaluated to satisfaction of instructor

INTRODUCTION TO PRUNING
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify tree structures and use pruning tools properly. This knowledge will be evidenced by completion of the assignment sheets, job sheet, and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with pruning to the correct definitions.
2. Select from a list reasons for pruning.
3. List kinds of pruning.
4. Identify tools used for pruning.
5. Match pruning tools to their correct uses.
6. State rules for care of pruning equipment.
7. Select from a list tools for sharpening blades.
8. Identify tree structures.
9. Check pruning equipment availability and prices.
10. Sharpen a pruning knife.

INTRODUCTION TO PRUNING
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information sheet.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Make transparencies.

   F. Contact other instructors, state agricultural colleges, or manufacturers for equipment sources.

   G. Bring pruning equipment into classroom and explain uses.

   H. Take a field trip to observe proper pruning methods.

   I. Give test.

   J. Reteach if necessary.

II. Instructional materials

   A. Objective sheet

   B. Information sheet

   C. Transparency Master #1--Tree Structures

   D. Assignment sheets

      1. Assignment Sheet #1--Check Pruning Equipment Availability and Prices

      2. Assignment Sheet #2--Identify Tree Structures

   E. Answers to assignment sheet

   F. Job Sheet #1--Sharpen a Pruning Knife

   G. Test

   H. Answers to test

III. Unit references:

A. Christopher, Everett P. *The Pruning Manual*. 11th ed. New York: Macmillan Publishing Company, Inc., 1954.

B. Grounds, Roger, editor. *The Complete Handbook of Pruning*. New York: Macmillan Publishing Company, Inc., 1973.

C. Mitchell, Paul J. *Pruning Ornamental Trees and Shrubs*. Stillwater: Oklahoma State University Extension Facts No. 6409, n.d.

INTRODUCTION TO PRUNING
UNIT I

INFORMATION SHEET

I. Terms and definitions

  A. Trunk-Part of the tree which connects the root system and branches

  B. Scaffold-Subdivision of the trunk; large branches

  C. Leader-Dominant growing point found in the top of a tree

  D. Spur-Small branch which grows only 1/2" or less per year; site of fruit production in some trees

  E. Sucker-Leafy shoot arising from roots or from the crown of the tree

  F. Water sprout-Vegetative shoot arising from buds on the trunk or large branches; usually should be thinned out or eliminated

  G. Crotch - Area where large branches join the trunk

II. Reasons for pruning

  A. Remove dead or injured parts

  B. Control size

  C. Control shape

  D. Improve production of fruit trees

  E. Improve root and top growth balance when transplanting

  F. Control amount of shade

  G. Renew vigor of old plants

III. Kinds of pruning

  A. Natural form

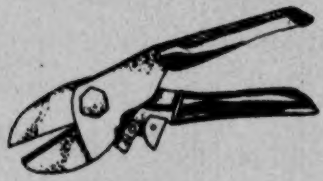
  B. Geometric form

INFORMATION SHEET

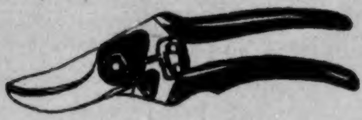
IV. Tools for pruning

A. Hand pruners

1. Anvil-type

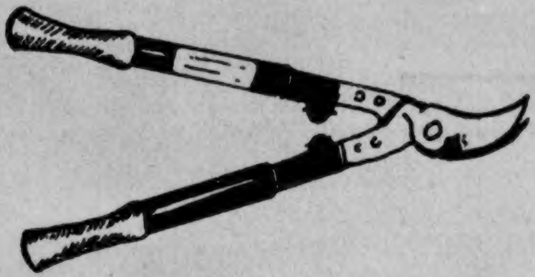


2. Blade, scissor, or shear-type



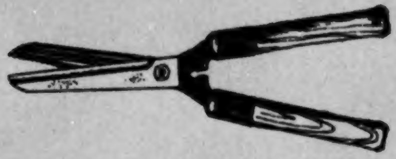
B. Lopping shears (loppers)

(NOTE: Aluminum, steel, fiberglass, and wooden handles are available, but steel and wood are more durable. Select loppers with rubber pads on the inside of the handle to act as shock absorbers.)



C. Hedge shears

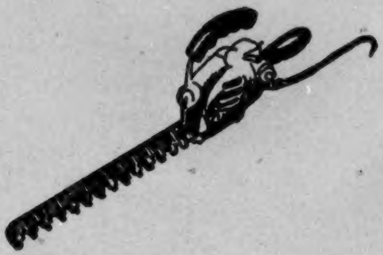
1. Mechanical hedge shears



INFORMATION SHEET

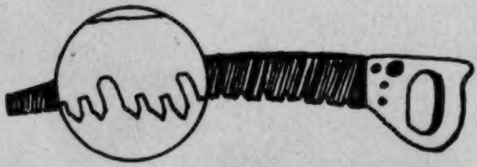
2. Electric hedge shears

(NOTE: Wear protective leather gloves and goggles when using electrical hedge shears.)

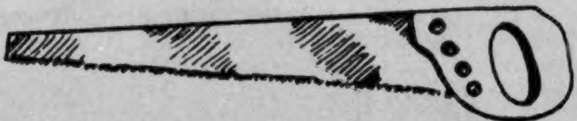


D. Pruning saws (pull cut)

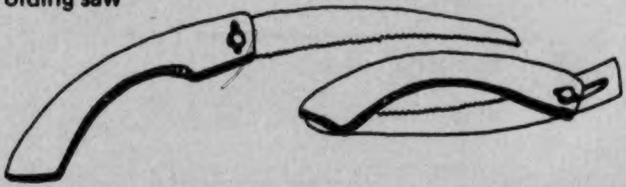
1. Curved blade



2. Straight blade

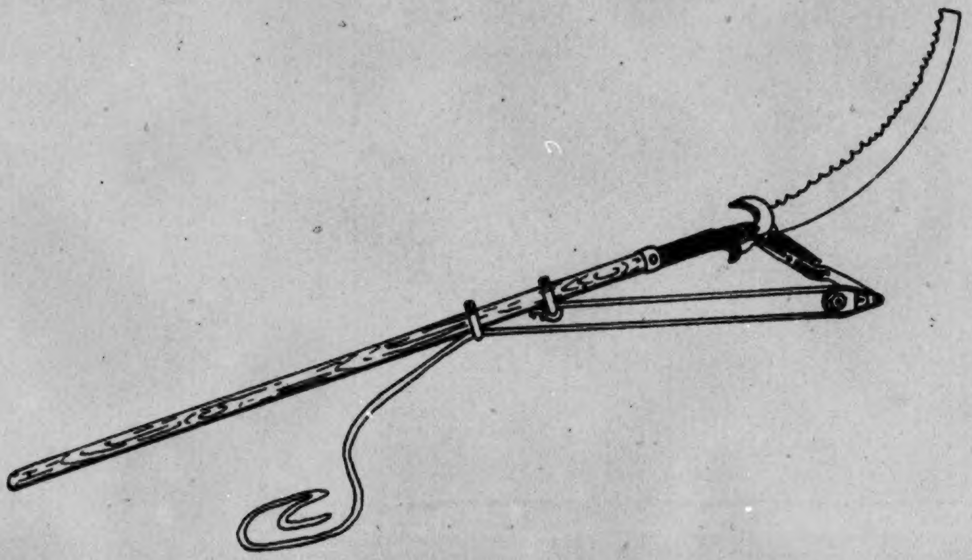


3. Folding saw



INFORMATION SHEET

E. Pole pruners



(NOTE: Chain saws are often used for large-scale removal. However, if proper pruning practices are used in early growth stages, chain saws will not be needed.)

V. Correct uses for pruning tools

A. Hand pruners-Removal of small branches no larger than a pencil

B. Lopping shears-Removal of branches from pencil size to 1 1/4" in diameter

C. Hedge shears-Shaping hedges and some evergreens

Examples: Privet, arborvitae

D. Pruning saw-Removal of branches larger than 1 1/4" in diameter

E. Pole pruners-Removal of branches that are out of reach

VI. Care of pruning equipment

A. Keep tools clean

B. Keep tools sharp

C. Keep tools properly adjusted

D. Oil tools often

INFORMATION SHEET

- E. Select the proper tool for the job

  (NOTE: Equipment can be ruined when forced to cut oversized branches.)

- F. Do not twist tools when in use
- G. Handle tools carefully and safely
- H. Store tools away from children and weather

VII. Tools for sharpening blades

- A. Whetstone
- B. Grindstone
- C. Sharpening steel

  (NOTE: Sharpening a saw should be left to an expert; carborundum stones should not be used on blades as they remove too much metal.)

VIII. Tree structures (Transparency 1)

- A. Trunk
- B. Scaffold
- C. Leader

  (NOTE: If a double leader occurs, one must be removed for correct tree shape.)

- D. Spur

  (NOTE: Spurs bear fruit and should not be removed from fruit trees.)

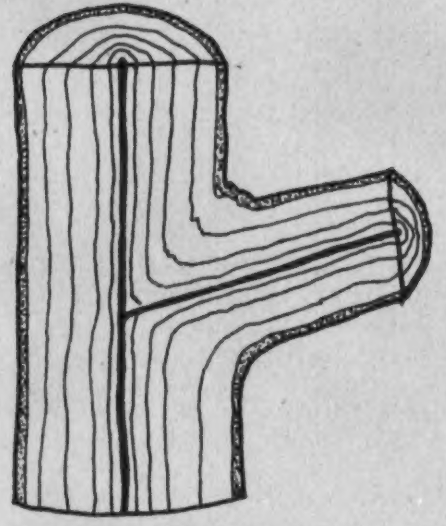
- E. Shoots
  1. Sucker
  2. Water sprout
- F. Crotch
  1. Weak formation
  2. Strong formation

INFORMATION SHEET

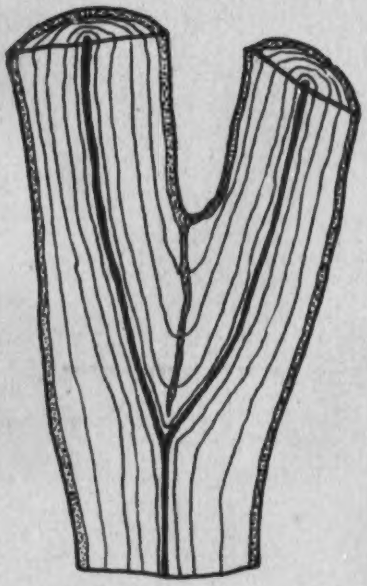
3. Multiple formation

(NOTE: Weak and multiple crotch formations are undesirable and should be avoided.)

Example:



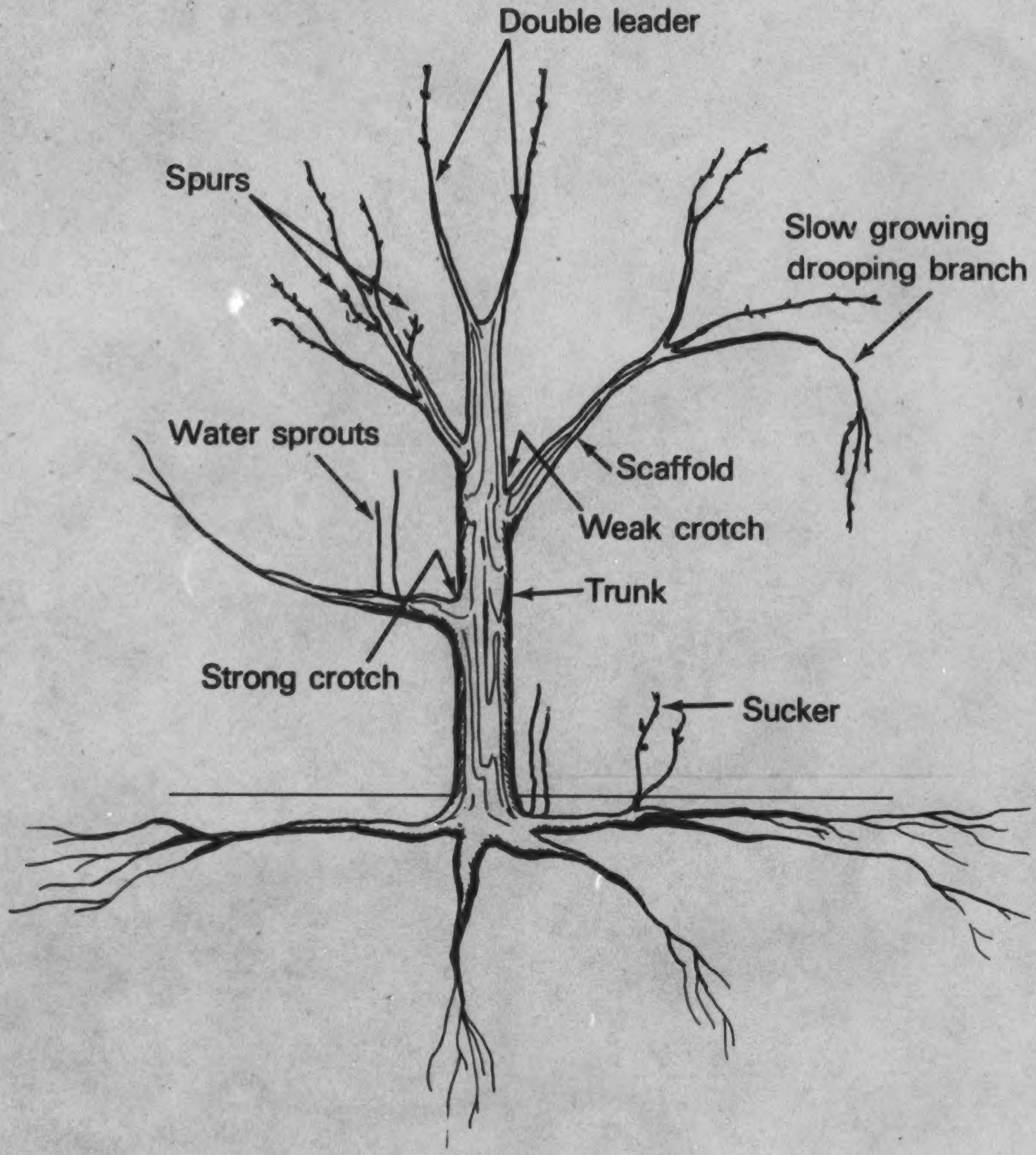
Strong



Weak

Used with permission of Macmillan Publishing Co., Inc. from *The Pruning Manual* by Everett P. Christopher, copyright 1974.

Tree Structures


Double leader
Spurs
Slow growing
drooping branch
Water sprouts
Scaffold
Weak crotch
Trunk
Strong crotch
Sucker

INTRODUCTION TO PRUNING
UNIT I

ASSIGNMENT SHEET #1--CHECK PRUNING EQUIPMENT AVAILABILITY AND PRICES

NAME________________________________ SCORE________________

Visit a garden supply or greenhouse supply store. Select at least five different types of pruning equipment. Then fill in the chart below.

(NOTE: If a supply store is not available, you may use a catalog.)

Tool	Source	Cost	Use

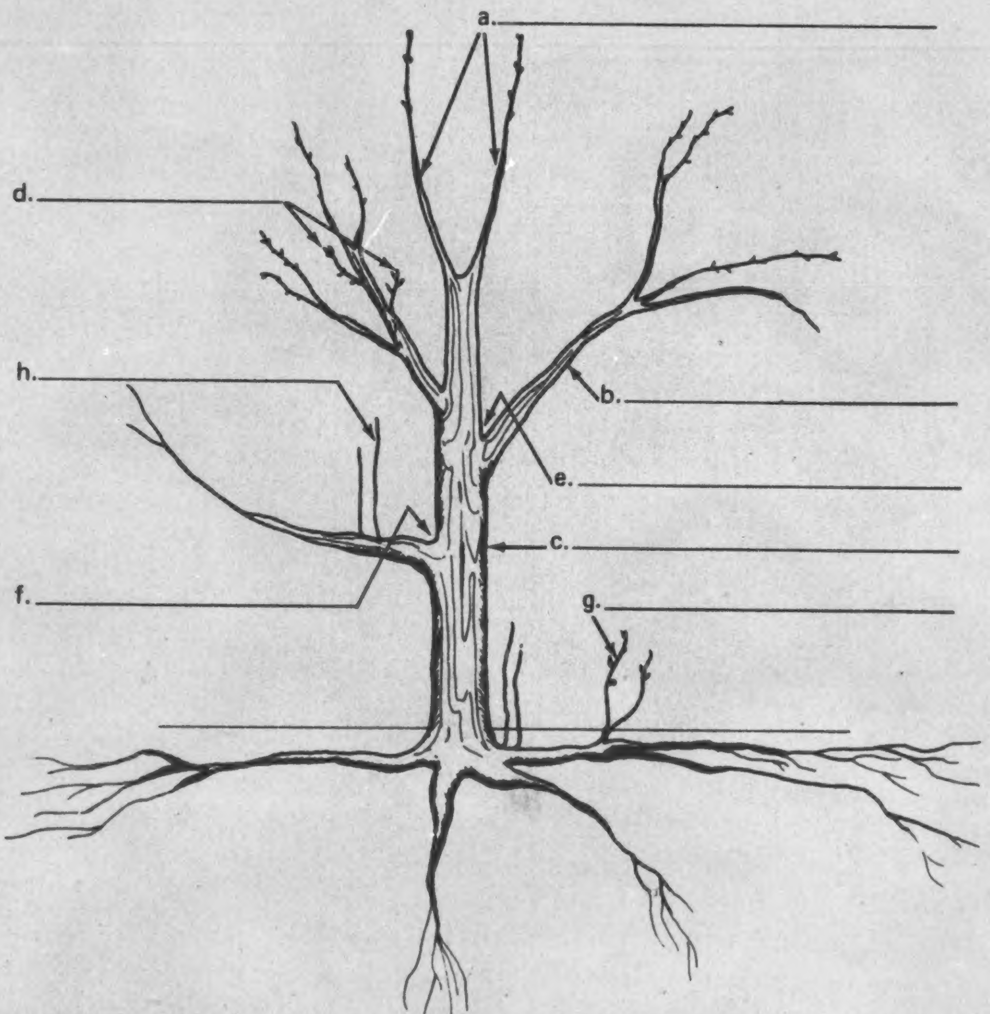
INTRODUCTION TO PRUNING
UNIT I

ASSIGNMENT SHEET #2--IDENTIFY TREE STRUCTURES

NAME______________________________ SCORE____________

Before you begin pruning you should be familiar with tree structures. Identify the parts shown below by writing the correct names in the blanks provided.

Double Leader
Sucker
Weak crotch
Spurs
Strong Crotch
Trunk
Scaffold
Water sprouts



INTRODUCTION TO PRUNING
UNIT I

ANSWERS TO ASSIGNMENT SHEET #2

a. Double Leader

b. Scaffold

c. Trunk

d. Spurs

e. Weak crotch

f. Strong crotch

g. Sucker

h. Water sprouts

INTRODUCTION TO PRUNING
UNIT I

JOB SHEET #1--SHARPEN A PRUNING KNIFE

I. Materials and equipment

- A. Pruning knife--Single or double bevel
- B. Coarse-grained stone
- C. Fine-grained stone

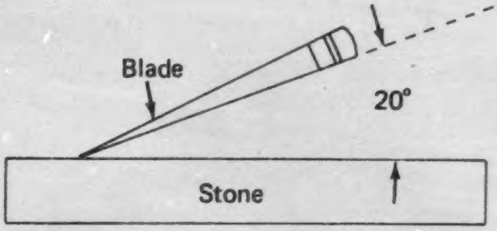
II. Procedure

A. Place coarse-grained stone on flat surface such as a table

(CAUTION: Do not work in your lap.)

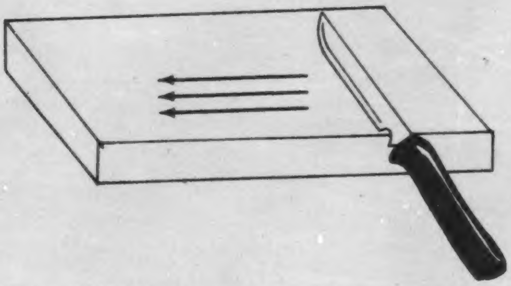
B. Place the knife blade on the surface of the stone at a 20° angle (Figure 1)

FIGURE 1



C. Run the blade down the stone, using the entire width of the stone to keep it flat (Figure 2)

FIGURE 2



(NOTE: Knife should be held so that only the edge of the blade touches the stone.)

D. Use same procedure with fine-grained stone for final grinding and smoothing

(NOTE: This procedure is basic to sharpening all types of blade equipment.)

INTRODUCTION TO PRUNING
UNIT I

TEST

NAME____________________________ SCORE______________________

1. Match terms associated with pruning to the correct definitions. Write the correct numbers in the blanks provided.

_____a. Area where large branches join the trunk

_____b. Leafy shoot arising from roots or from the crown of the tree

_____c. Vegetative shoot arising from buds on the trunk or large branches; usually should be thinned out or eliminated

_____d. Part of the tree which connects the root system and branches

_____e. Subdivision of the trunk; large branches

_____f. Small branch which grows only 1/2" or less per year; site of fruit production in some trees

_____g. Dominant growing point found in the top of a tree

1. Trunk
2. Scaffold
3. Leader
4. Spur
5. Sucker
6. Water sprout
7. Crotch

2. Select from the list below reasons for pruning. Mark each correct answer with an "X".

_____a. Remove dead or injured parts

_____b. Prevent flowering

_____c. Control shape

_____d. Reduce maintenance

_____e. Control pests

_____f. Control size

_____g. Improve production of fruit trees

_____h. Control disease

_____i. Renew vigor of old plants

_____j. Eventual removal of the tree

_____k. Control amount of shade

_____l. Improve root and top growth balance when transplanting

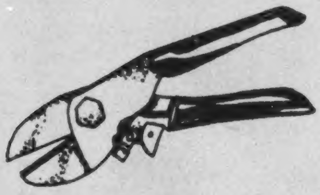
3. List kinds of pruning.

a. ____________________

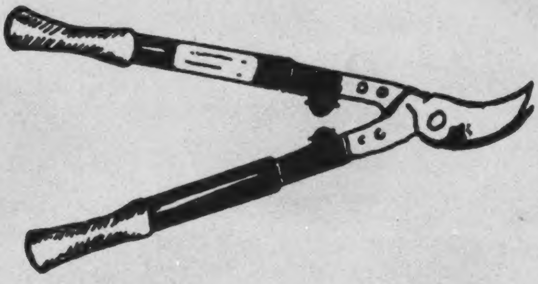
b. ____________________

4. Identify tools used for pruning from the following illustrations. Write the correct names in the blanks provided.

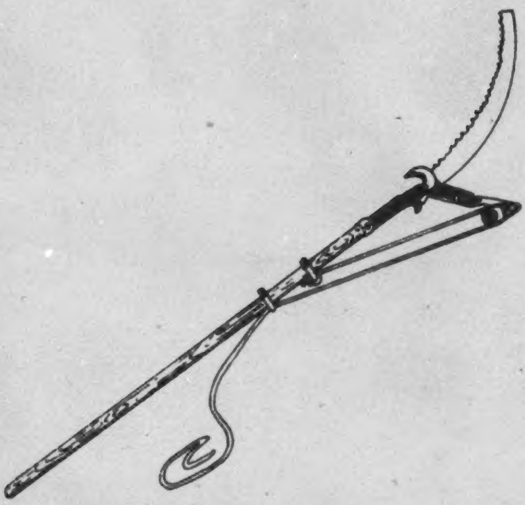
Mechanical hedge shears
Straight blade pruning saw
Pole pruners
Blade, scissor, or shear-type hand pruners
Electric hedge shears
Lopping shears (loppers)
Curved blade pruning saw
Anvil-type hand pruner
Folding saw



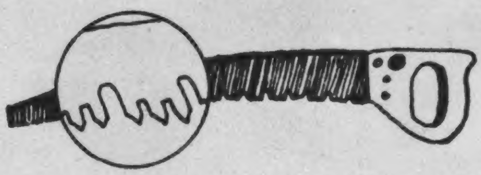
a. ____________________



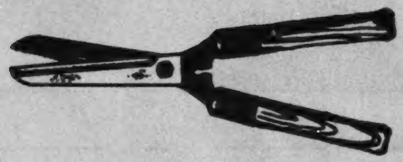
b. ____________________



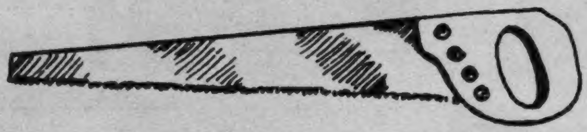
c. ____________________



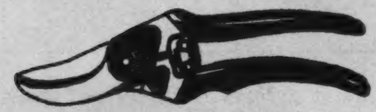
d. ____________________



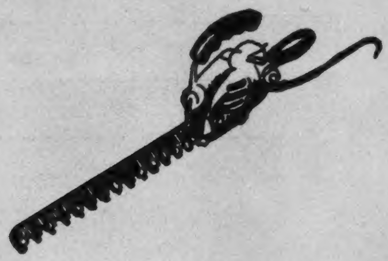
e. ______________________



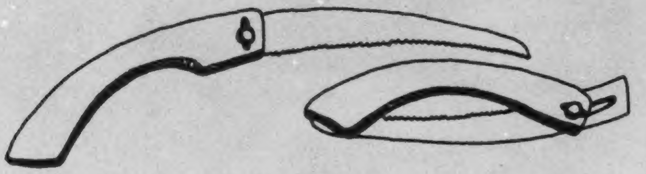
f. ______________________



g. ______________________



h. ______________________



i. ______________________

5. Match pruning tools to their correct uses. Write the correct numbers in the blanks provided.

_____a. Removal of branches that are out of reach

_____b. Removal of branches from pencil size to 1 1/4" in diameter

_____c. Removal of small branches no larger than a pencil

_____d. Removal of branches larger than 1 1/4" in diameter

_____e. Shaping hedges and some evergreens

1. Hand pruners
2. Lopping shears
3. Hedge shears
4. Pruning saw
5. Pole pruners

6. State rules for care of pruning equipment in the blanks below.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

   f. ____________________

   g. ____________________

   h. ____________________

7. Select from the list below tools for sharpening blades. Mark each correct answer with an "X."

   ______a. Carborundum stone

   ______b. File

   ______c. Whetstone

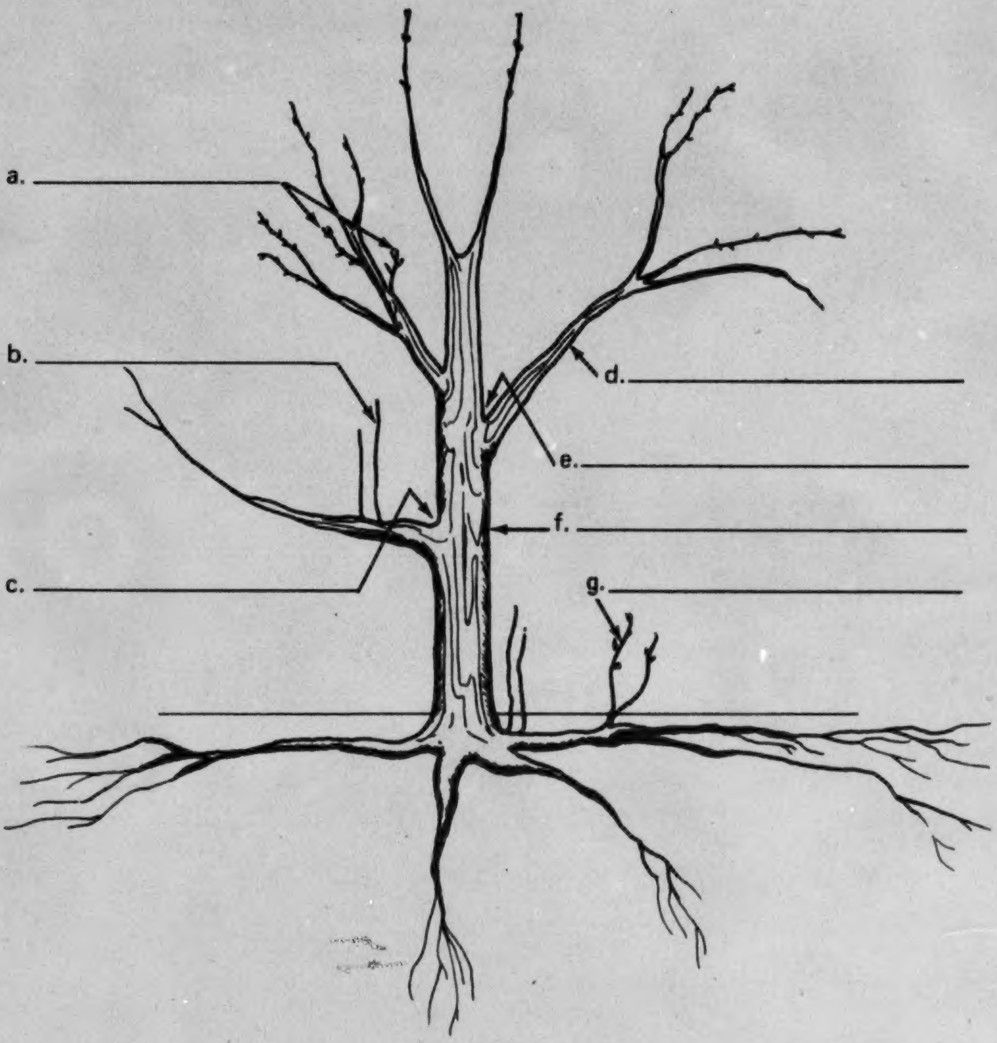
   ______d. Sharpening steel

   ______e. Grindstone

   ______f. Chisel

8. Identify the following tree structures by writing the correct names in the blanks provided.

Water sprouts
Trunk
Scaffold
Strong crotch
Weak crotch
Sucker
Spurs



9. Check pruning equipment availability and prices.

10. Sharpen a pruning knife.

(NOTE: If activities 9 and 10 have not been finished before test, ask your instructor when they should be completed.)

INTRODUCTION TO PRUNING
UNIT I

ANSWERS TO TEST

1. a. 7
   b. 5
   c. 6
   d. 1
   e. 2
   f. 4
   g. 3
2. a, c, f, g, i, k, l
3. a. Natural form
   b. Geometric form
4. a. Anvil-type hand pruner
   b. Lopping shears (loppers)
   c. Pole pruners
   d. Curved blade pruning saw
   e. Mechanical hedge shears
   f. Straight blade pruning saw
   g. Blade, scissor, or shear-type hand pruners
   h. Electric hedge shears
   i. Folding saw
5. a. 5
   b. 2
   c. 1
   d. 4
   e. 3

6. a. Keep tools clean
   b. Keep tools sharp
   c. Keep tools properly adjusted
   d. Oil tools often
   e. Select the proper tool for the job
   f. Do not twist tools when in use
   g. Handle tools carefully and safely
   h. Store tools away from children and weather
7. c, d, e
8. a. Spurs
   b. Water sprouts
   c. Strong crotch
   d. Scaffold
   e. Weak crotch
   f. Trunk
   g. Sucker
9. Evaluated to satisfaction of instructor
10. Evaluated to satisfaction of instructor

PRUNING TREES AND SHRUBS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to demonstrate the ability to prune ornamental trees and shrubs. This knowledge will be evidenced by completion of job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to:

1. Match terms associated with pruning to the correct definitions.
2. Match types of trees or shrubs to proper pruning times.
3. Select from a list rules for proper pruning.
4. List in order steps in removing large branches.
5. Arrange in order steps in treatment of cavities.
6. Demonstrate the ability to:
    a. Prune ornamental deciduous trees.
    b. Prune ornamental deciduous shrubs.
    c. Prune broadleaf evergreens.
    d. Prune coniferous evergreens.

PRUNING TREES AND SHRUBS
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

  A. Provide student with objective sheet.

  B. Provide student with information and job sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information sheet.

  E. Demonstrate and discuss procedures outlined in job sheets.

  F. Take a field trip in the community to observe proper and improper pruning methods.

  G. Invite a guest speaker from a garden center, landscape firm, or county extension center to discuss pruning.

  H. Give test.

  I. Reteach if necessary.

II. Instructional materials:

  A. Objective sheet

  B. Information sheet

  C. Job sheets

    1. Job Sheet #1--Prune Ornamental Deciduous Trees

    2. Job Sheet #2--Prune Ornamental Deciduous Shrubs

    3. Job Sheet #3--Prune Broadleaf Evergreens

    4. Job Sheet #4--Prune Coniferous Evergreens

  D. Test

  E. Answers to test

III. Unit references:

  A. Christopher, Everett P. *The Pruning Manual*. New York: Macmillian Publishing Co., Inc., 1954.

  B. Grounds, Roger, editor. *The Complete Handbook of Pruning*. New York: Macmillan Publishing Co., Inc., 1973.

C. *Pruning Ornamental Trees and Shrubs*. Stillwater: OSU Extension Facts, No. 6409.

D. Free, Montague. *Plant Pruning in Pictures.* New York: Doubleday and Co, Inc., 1961.

PRUNING TREES AND SHRUBS
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Deciduous--Trees or shrubs that lose their leaves in the fall

   B. Evergreens--Trees or shrubs which keep foliage all year round

   C. Dehorning--Removing large branches, leaving a large stub and no young growth

   D. Head back--Removing a part of a branch back to a bud or side branch in order to control direction of growth

   E. Thin out--Removing an entire branch or sprout to maintain vigorous growth

   F. Candle--Immature growth on coniferous evergreens

      Examples: Pine, spruce, fir

      (NOTE: Tight growth can be achieved by pinching new candles when they are approximately 2" long, removing half the candle.)

II. Proper pruning times

   A. Deciduous trees and shrubs

      1. Spring flowering--Prune after flowers have faded

         (NOTE: Summer, fall, or winter pruning destroys flower buds.)

         Examples: Flowering crabapple, lilac, forsythia

      2. Summer flowering--Prune in early spring or when flowers fade in early fall

         Examples: Crape myrtle, althea

      3. Shade trees (flowers are insignificant)--Prune any season

         Example: Oak

         (NOTE: Exceptions are "bleeders" which emit a clear sap if pruned between February 1 and new growth in spring. Examples of bleeders are maple, birch, and elm; these should be pruned in January or July.)

   B. Broadleaf evergreens--Prune just before new growth begins in spring

      Examples: Nandina, boxwood, hollies

INFORMATION SHEET

C. Narrowleaf evergreens

1. Needleleaf--Prune no more than half the length of the candle before new needles reach full size

   Examples: Pine, fir, spruce

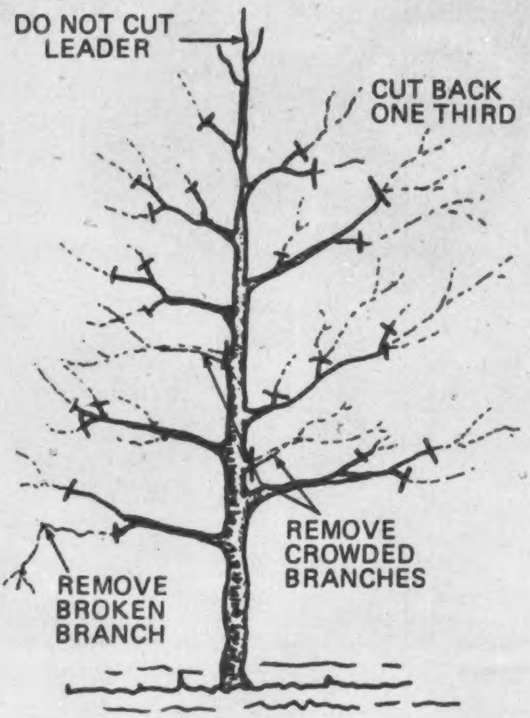
2. Scale-leaf--Prune just before new growth begins in spring; growth can be shaped or controlled by pruning between May and July

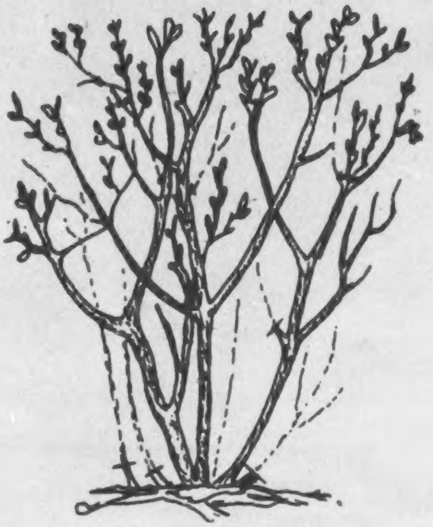
   Examples: Arborvitae, junipers

III. Rules for proper pruning

A. Never remove more than 1/3 of the branches from a tree or 2/3 of a shrub or vine per year

Examples:


DO NOT CUT LEADER
CUT BACK ONE THIRD
REMOVE CROWDED BRANCHES
REMOVE BROKEN BRANCH



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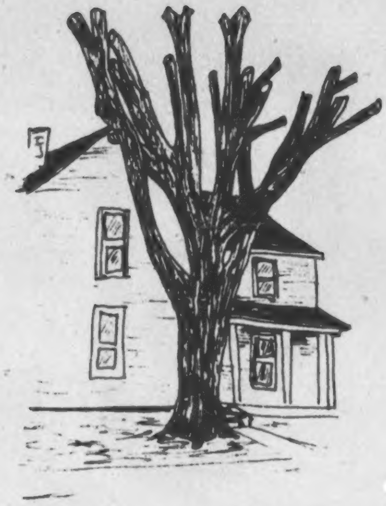
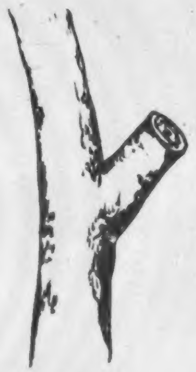
INFORMATION SHEET

(NOTE: Dehorning is considered butchery rather than pruning and most often shortens the life of a tree; it is not considered a recommended practice in any case. See illustration below.)



B. Remove branches flush with the trunk; do not leave a stub



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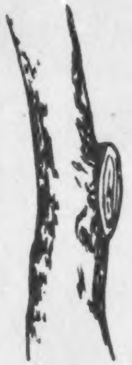

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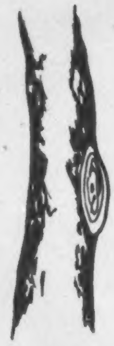

Correct

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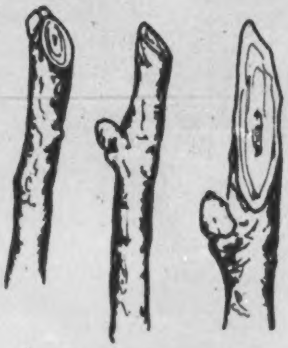
INFORMATION SHEET

C. Start at the end of a branch and work toward the trunk

D. Cut stems back to a bud or side branch facing the desired direction

(NOTE: Angle of the cut is important; if cut back to a branch, it should be at least 1/3 the size of the branch removed.)



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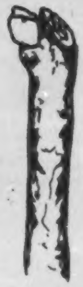

Correct

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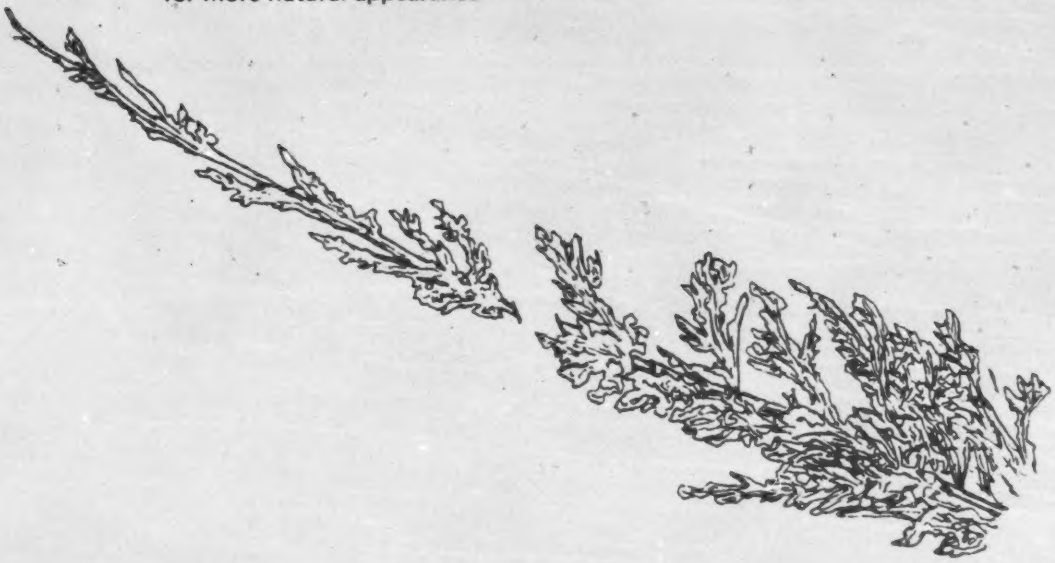
E. Slant cuts upward on evergreens, working from the underside of branch for more natural appearance

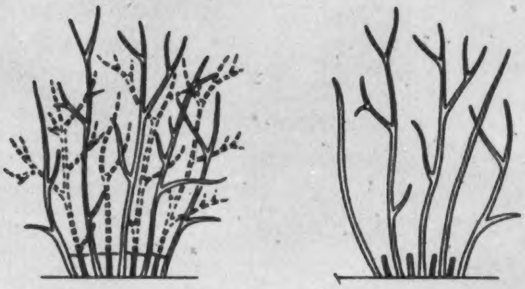


INFORMATION SHEET

F. Prune shrubs a bit each year; remove up to 1/3 of old stems at ground level and 1/3 to 1/2 of remaining top growth

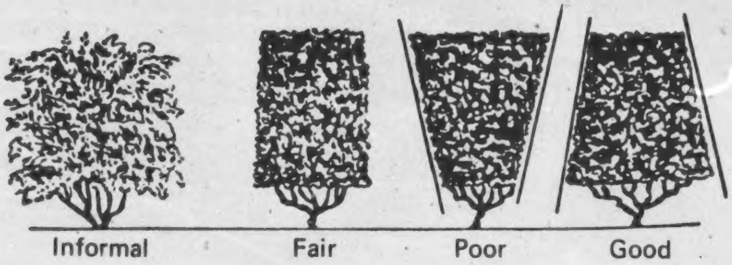
Examples: Forsythia, nandina, flowering quince

(NOTE: Evergreen shrubs require less pruning than deciduous shrubs.)



From *The Why and How of Home Horticulture* by Dr. R. Bienz. W. H. Freeman and Company, copyright 1980.

G. Prune hedges to have a broader base than top to avoid thinning and shading of lower branches



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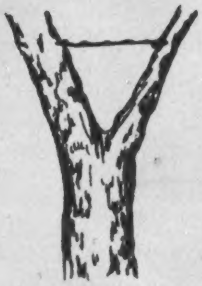
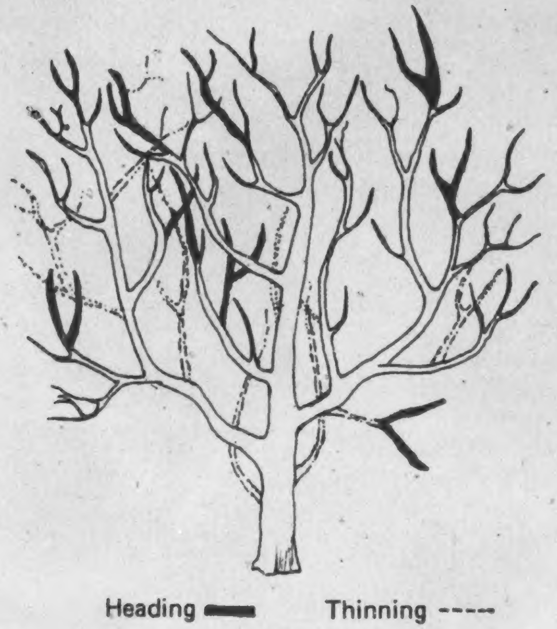
INFORMATION SHEET

H. Cabling may be necessary to support weak crotches



I. Head back or thin out to control tree shape and direction of growth



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IV. Steps in removing large branches

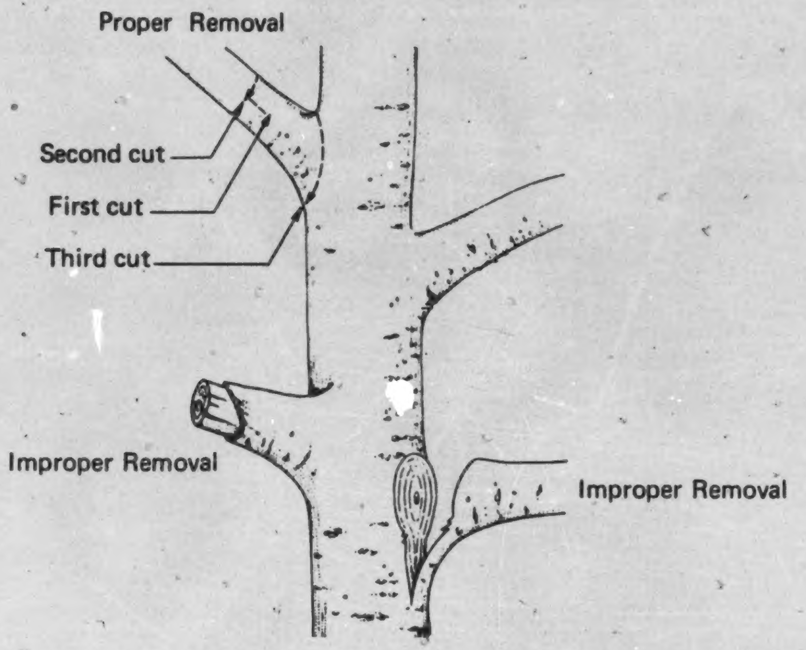
A. Undercut approximately 1/2 to 2/3 through the branch

B. Overcut beyond the first cut until the branch falls

INFORMATION SHEET

C. Remove stub flush with trunk

Example:


Proper Removal
Second cut
First cut
Third cut
Improper Removal
Improper Removal

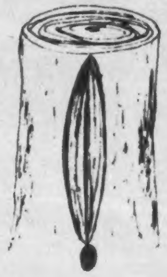
From *The Why and How of Home Horticulture* by Dr. R. Bienz. W. H. Freeman and Company, copyright 1980.

V. Treatment of cavities

A. Clean cavity of decay and discoloration

B. Shape cavity to prevent water pocket formation

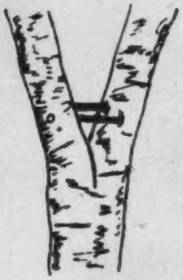
(NOTE: A hole should be drilled at the base of the cavity through the outside bark to allow drainage. See figure below.)

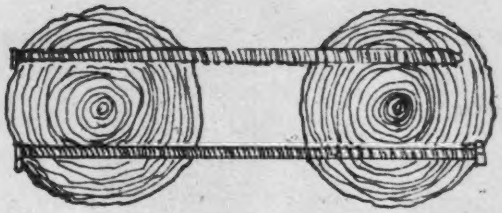


INFORMATION SHEET

C. Brace cavity if more sturdiness is needed

(NOTE: Bracing is done with screw rods.)





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D. Paint exposed wood with orange shellac

(NOTE: Some cavities may be filled with concrete or some other type of filler material if the cavity is large and will take a long time to heal.)

PRUNING TREES AND SHRUBS
UNIT II

JOB SHEET #1--PRUNE ORNAMENTAL DECIDUOUS TREES

I. Materials and equipment

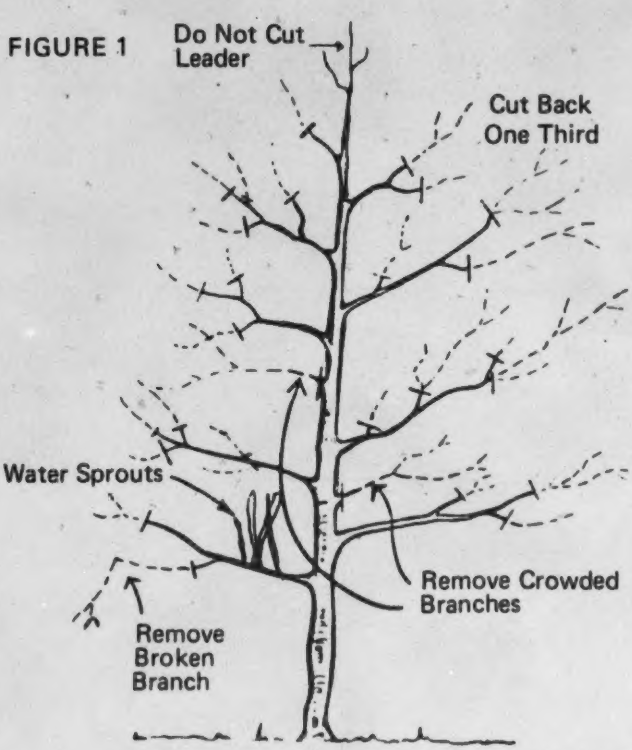
- A. Hand pruners
- B. Lopping shears
- C. Pruning saw

  (NOTE: Small folding saws are most convenient.)
- D. Ladder if necessary
- E. Pole pruners if necessary

II. Procedure

- A. Remove dead or damaged wood (Figure 1)

FIGURE 1

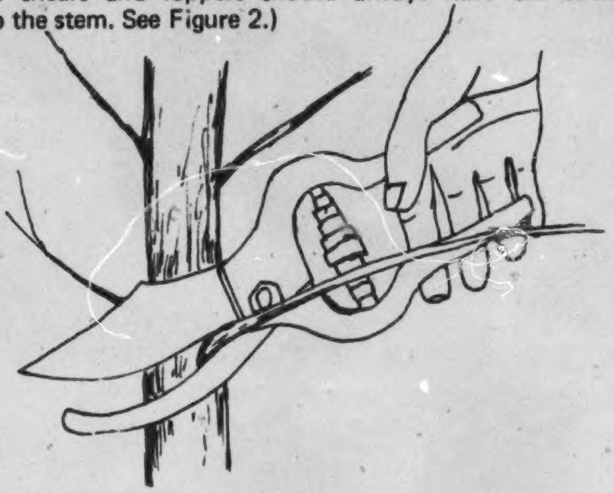

Do Not Cut Leader
Cut Back One Third
Water Sprouts
Remove Crowded Branches
Remove Broken Branch

Adapted with permission of Doubleday & Co., Inc. from *Plant Pruning in Pictures* by Montague Free, copyright 1961.

JOB SHEET #1

(NOTE: Blade-type shears and loppers should always have the cutting blade placed next to the stem. See Figure 2.)

FIGURE 2



B. Remove diseased wood (Figure 1)

C. Remove branches that rub or cross (Figure 1)

D. Remove water sprouts from branches (Figure 1)

(NOTE: If a sprout is selected for a main branch, cut back other sprouts about half length one year and remove them the next year to prevent new water sprout development.)

E. Head back to achieve form (Figure 1)

F. Thin out to achieve form (Figure 1)

(NOTE: Tree shape is determined by natural growth pattern. Know correct shape before you begin.)

PRUNING TREES AND SHRUBS
UNIT II

JOB SHEET #2--PRUNE ORNAMENTAL DECIDUOUS SHRUBS

I. Materials and equipment

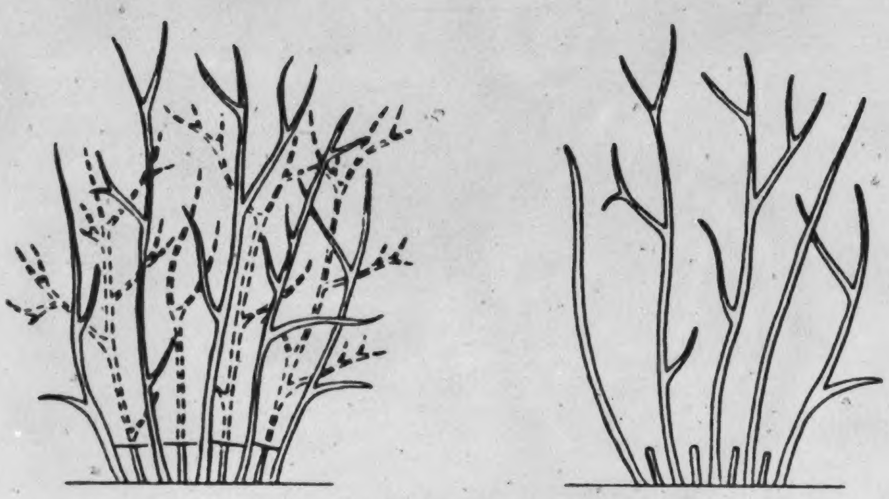
A. Hand pruners

B. Lopping shears

II. Procedure

A. Select three to five strong shoots the first year for framework (Figure 1)

FIGURE 1



From *The Why and How of Home Horticulture* by Dr. R. Bienz. W. H. Freeman and Company, copyright 1980.

B. Remove all other shoots

C. Prune strong shoots back to 3 or 4 buds to encourage growth

D. Remove up to 1/3 of old stems at ground level and 1/3 to 1/2 of remaining top growth

(NOTE: Time of pruning depends on the age of the wood on which flowering occurs. Be familiar with your plant material.)

PRUNING TREES AND SHRUBS
UNIT II

JOB SHEET #3--PRUNE BROADLEAF EVERGREENS

I. Materials and equipment

   A. Broadleaf evergreen

      Example: Hollies

   B. Hand pruners

   C. Loppers

   D. Pruning saw

II. Procedure

   A. Remove dead or damaged wood

   B. Remove diseased wood

   C. Remove branches that rub or cross

   D. Remove tip of stems to encourage branching and a fuller plant

   E. Head back to achieve form

   F. Thin out to achieve form

      (NOTE: Evergreens should be pruned annually, removing about 1/2 of new growth each year to keep plant actively growing.)

PRUNING TREES AND SHRUBS
UNIT II

JOB SHEET #4--PRUNE CONIFEROUS EVERGREENS

I. Materials and equipment

   A. Narrowleaf evergreen

      Examples: Fir, pine, spruce

   B. Hand pruners

   C. Loppers

   D. Pruning saw

II. Procedure

   A. Reduce distance between branches by cutting the central leader six weeks after candles begin to elongate in spring; remove about half the candle, cutting at an angle to encourage staggered new growth

   B. Keep branches short by pinching terminal buds

   C. Shorten long branches to an inner lateral branch

   D. Remove a double leader

PRUNING TREES AND SHRUBS
UNIT II

TEST

NAME______________________________________ SCORE____________

1. Match terms associated with pruning to the correct definitions. Write the correct numbers in the blanks.

_____a. Removing large branches, leaving a large stub and no young growth

_____b. Trees or shrubs that lose their leaves in the fall

_____c. Removing an entire branch or sprout to maintain vigorous growth

_____d. Trees or shrubs which keep foliage all year round

_____e. Removing a part of a branch back to a bud or side branch in order to control direction of growth

_____f. Immature growth on coniferous evergreens

1. Evergreens
2. Deciduous
3. Dehorning
4. Head back
5. Candle
6. Thin out

2. Match types of trees or shrubs to proper pruning times. Write the correct numbers in the blanks.

_____a. Prune just before new growth begins in spring

_____b. Prune any season

_____c. Prune in early spring or when flowers fade in early fall

_____d. Prune after flowers have faded

_____e. Prune no more than half the length of the candle before new needles reach full size

_____f. Prune just before new growth begins in spring; growth can be shaped or controlled by pruning between May and July

1. Needleleaf evergreens
2. Scale-leaf evergreens
3. Summer-flowering deciduous trees and shrubs
4. Spring-flowering deciduous trees and shrubs
5. Shade trees
6. Broadleaf evergreens

3. Select from the list below rules for proper pruning. Mark each correct answer with an "X."

_____a. Never remove more than 1/2 the branches from a tree or 3/4 of a shrub or vine per year

_____b. Remove branches flush with the trunk; do not leave a stub

_____c. Start at the end of a branch and work toward the trunk _____d. Cut stems back to any bud

_____e. Slant cuts downward on evergreens, working for a more natural appearance

_____f. Prune shrubs a bit each year; remove up to 1/3 of old stems at ground level and 1/3 to 1/2 of remaining top growth

_____g. Prune hedges to have a broader base than top to avoid thinning and shading of lower branches

_____h. Cabling may be necessary to support weak crotches

_____i. Head back or thin out to control tree shape and direction of growth

4. List in order steps in removing large branches.

a. ____

b. ____

c. ____

5. Arrange in order steps in treatment of cavities.

_____a. Shape cavity to prevent water pocket formation

_____b. Paint exposed wood with orange shellac

_____c. Clean cavity of decay and discoloration

_____d. Brace cavity if more sturdiness is needed

6. Demonstrate the ability to:

a. Prune ornamental deciduous trees.

b. Prune ornamental deciduous shrubs.

c. Prune broadleaf evergreens.

d. Prune coniferous evergreens.

(NOTE: If the above activities have not been finished before the test, ask your instructor when they should be completed.)

PRUNING TREES AND SHRUBS
UNIT II

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 6
   d. 1
   e. 4
   f. 5
2. a. 6
   b. 5
   c. 3
   d. 4
   e. 1
   f. 2
3. b, c, f, g, h, i
4. a. Undercut approximately 1/2 to 2/3 through the branch
   b. Overcut beyond the first cut until the branch falls
   c. Remove stub flush with trunk
5. a. 2
   b. 4
   c. 1
   d. 3
6. Performance skills evaluated to satisfaction of instructor

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to trim a hedge and train plant material to an espalier. This knowledge will be evidenced by completion of the job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with special purpose pruning training and methods with the correct definitions.
2. Identify hedge shapes.
3. Label common topiary shapes.
4. List plants grown as topiary.
5. Label common espalier shapes.
6. List plants grown espalier.
7. Demonstrate the ability to:
    a. Trim a hedge.
    b. Train plant material to an espalier.

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

   A. Provide student with objective sheet.

   B. Provide student with information sheet.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in the job sheets.

   F. Visit local garden centers to observe topiary and espaliered plants.

   G. Have a guest speaker from a nursery or plant maintenance firm demonstrate espalier, hedge, and topiary techniques.

   H. Locate hedges in need of pruning; check with owners for permission and desired shape.

   I. Give test.

   J. Reteach if necessary.

II. Instructional materials

   A. Objective sheet

   B. Information sheet

   C. Job sheets

      1. Job Sheet #1--Trim a Hedge

      2. Job Sheet #2--Train Plant Material to an Espalier

   D. Test

   E. Answers to test

III. References

   A. Christopher, Everett P. *The Pruning Manual.* New York: Macmillan Publishing Company, Inc., 1974.

   B. Hill, Lewis. *Pruning Simplified.* Emmaus, Pennsylvania: Rodale Press, 1979.

   C. Grounds, Roger, ed. *The Complete Handbook of Pruning.* New York: Macmillan Publishing Company, Inc., 1973.

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Topiary--Trees trained into unusual shapes through pruning, tying, and wiring

B. Espalier--Controlled shape of plants against a wall or other support, requiring a wire framework and selective pruning

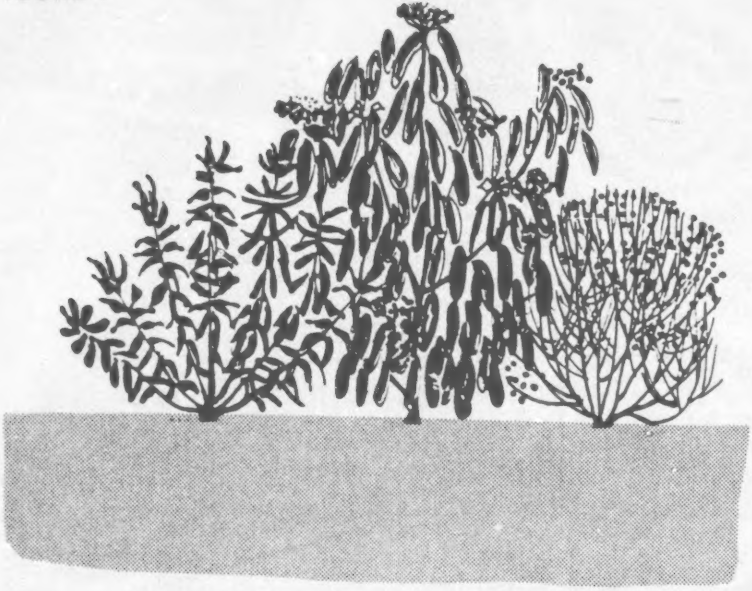
C. Hedge--A growing barrier

II. Hedge shapes

(NOTE: Hedges should always be more narrow at the top than the bottom to insure good light to all parts of the hedge.)

A. Informal

FIGURE 1



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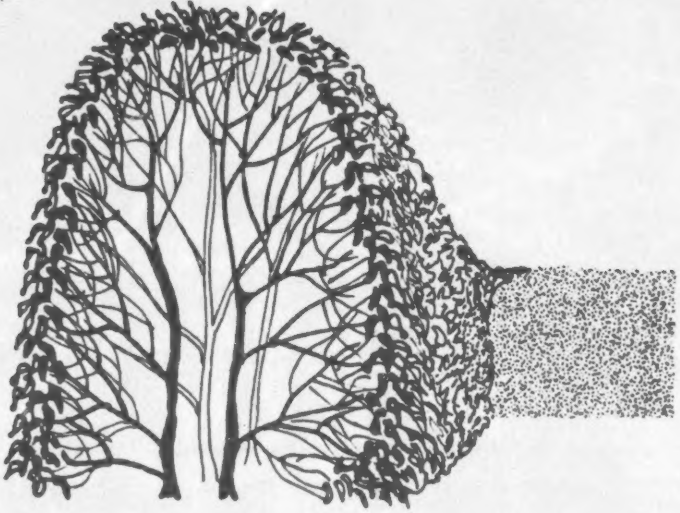
INFORMATION SHEET

B. Formal

1. Loaf shaped

FIGURE 2



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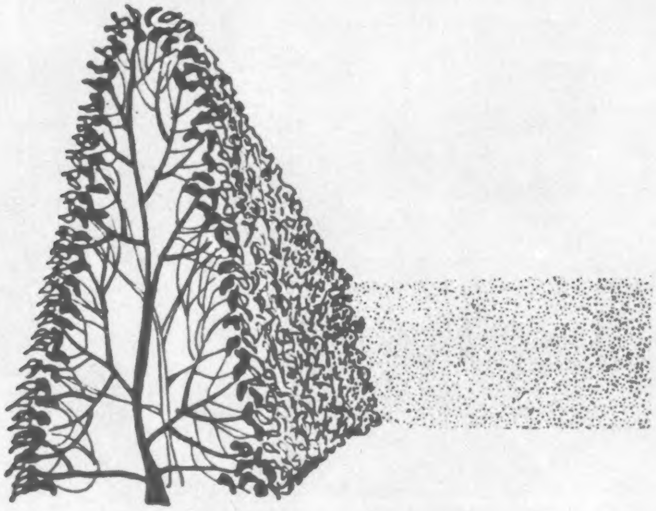
2. Elongated pyramid

FIGURE 3



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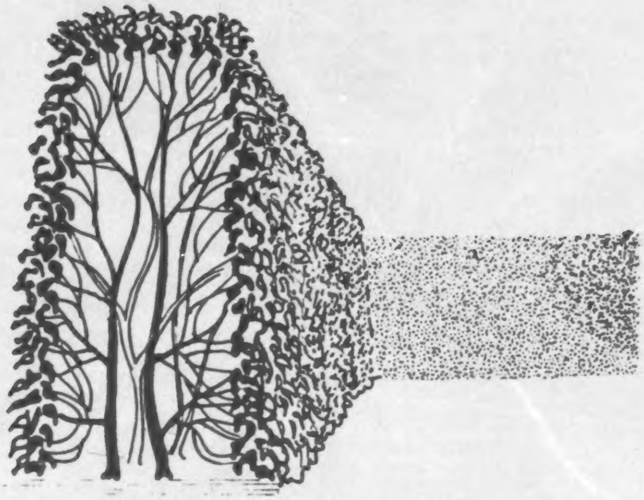
INFORMATION SHEET

3. Oblong

FIGURE 4



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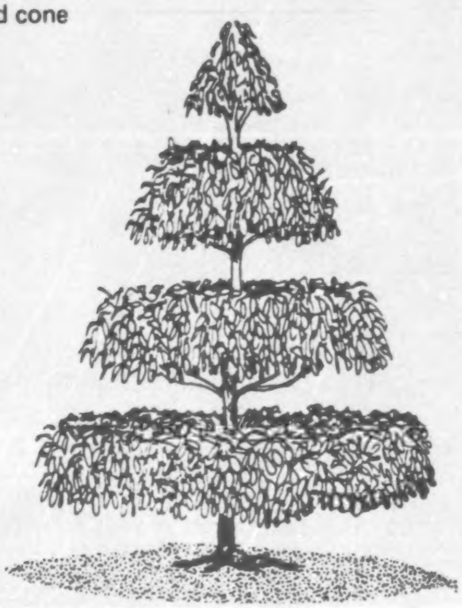
III. Common topiary shapes

A. Interrupted cone

FIGURE 5



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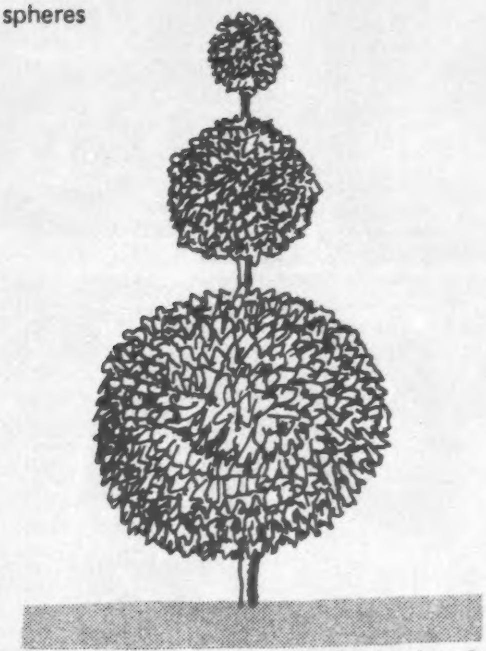
INFORMATION SHEET

B. Graduated spheres

FIGURE 6



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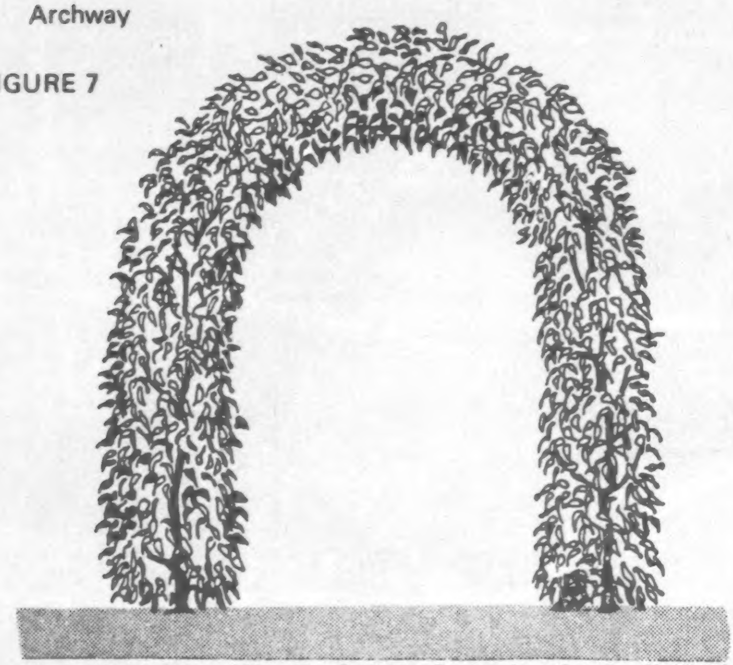
C. Archway

FIGURE 7



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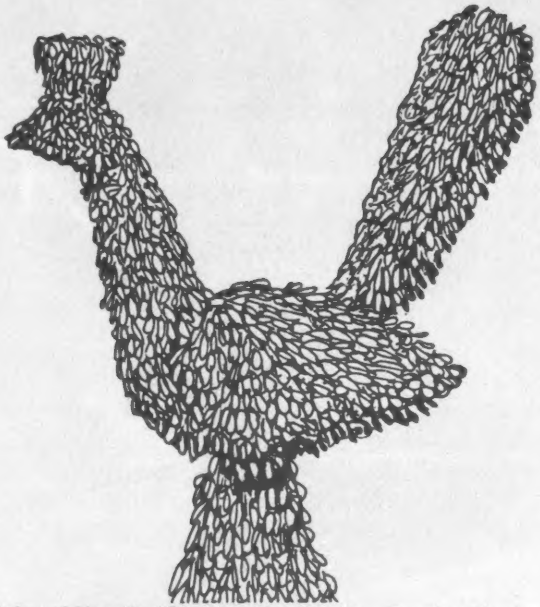
INFORMATION SHEET

D. Novelty shape

Examples: Elephants, birds

FIGURE 8



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IV. Plants grown as topiary

(NOTE: These plants are commonly grown as topiary; however, any plant with dense growth is suitable.)

A. Boxwood

B. Yew

C. Arborvitae

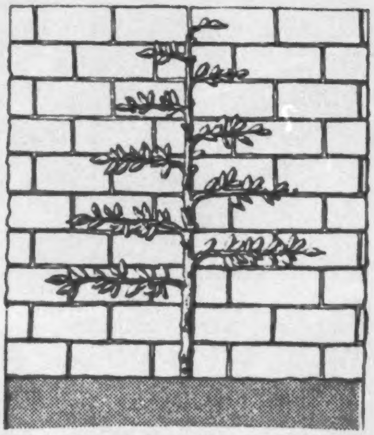
D. Junipers

INFORMATION SHEET

V. Common espalier shapes

A. Tiers

FIGURE 9



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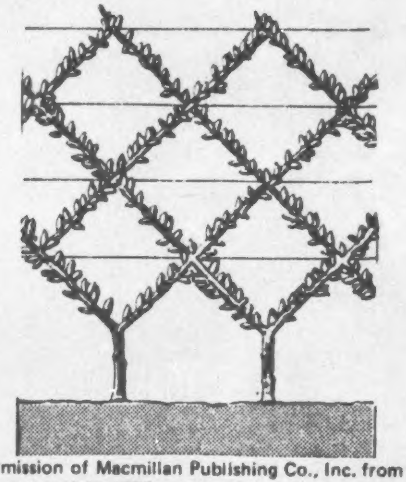
B. Diamond pattern

FIGURE 10



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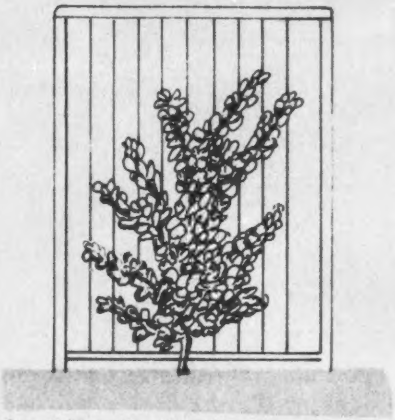
INFORMATION SHEET

C. Free-form

FIGURE 11



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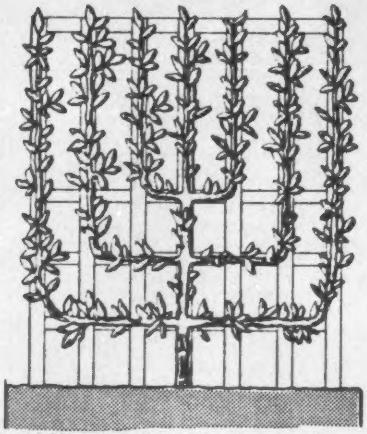
D. Candelabra

FIGURE 12



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VI. Plants grown espalier

A. English ivy

B. Pyracantha

C. Fruit trees

D. Vining roses

(NOTE: These plants are commonly espaliered; however, any plant that has long branches or vines can be espaliered.)

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

JOB SHEET #1--TRIM A HEDGE

I. Materials and equipment

A. Hedge shears

(NOTE: Electric hedge shears can be used but operator should be careful to wear goggles and leather gloves.)

B. Rake

C. Hedge row

II. Procedure

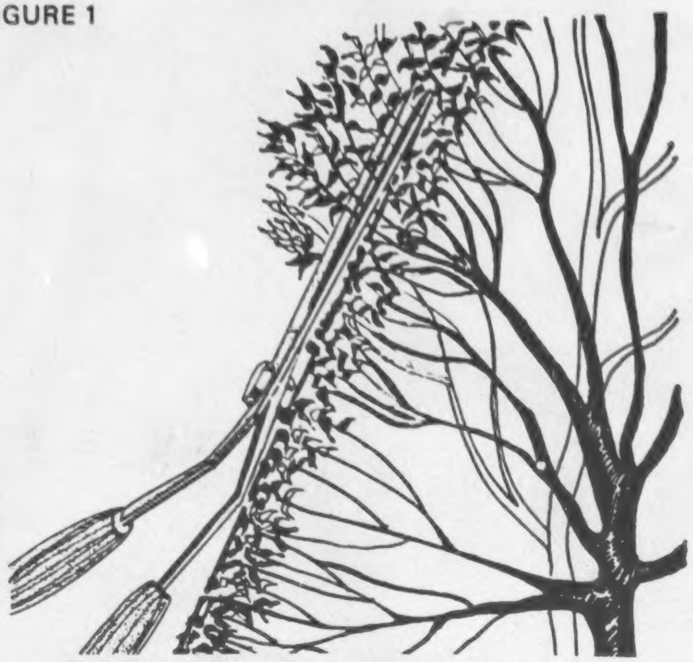
A. Determine desired shape

B. Prune top of hedge to desired height

C. Prune front and back of hedge to desired shape by holding blades flat against hedge (Figure 1)

(NOTE: Remember that the hedge should be wider at the base than at the top to allow sunlight to reach lower branches.)

FIGURE 1



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JOB SHEET #1

D. Rake all trimmings together and dispose of them

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

JOB SHEET #2–TRAIN PLANT MATERIAL TO AN ESPALIER

I. Materials and equipment

   A. Hand pruners

   B. Well-branched plant material several feet tall

      Examples: Pyracantha, small ornamental fruit trees

   C. Twine

   D. Wire framework or pegs to attach plant to wall

II. Procedure

   A. Select espalier pattern

   B. Select main branches

   C. Tie branches to wire framework, if used, or attach with wire pegs (Figures 1 and 2)

FIGURE 1

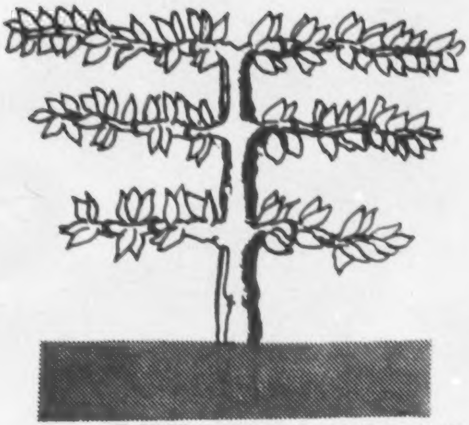


FIGURE 2

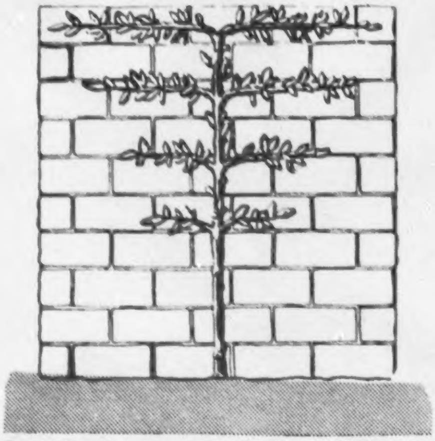


FIGURE 2 used with permission of Macmillan Publishing Co., Inc. from *Complete Handbook of Pruning,* Roger Grounds, editor, copyright 1973.

   D. Remove branches that do not conform to shape, leaving top intact

   E. Remove tips of branches if branching is needed for espalier shape

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

TEST

NAME ____ SCORE ________________

1. Match terms associated with special purpose pruning and training to the correct definitions. Write the correct numbers in the blanks.

_____a. Controlled shape of plants against a wall or other support, requiring a wire framework and selective pruning

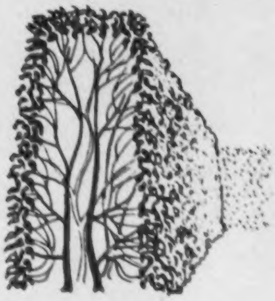
_____b. A growing barrier

_____c. Trees trained into unusual shapes through pruning, tying, and wiring

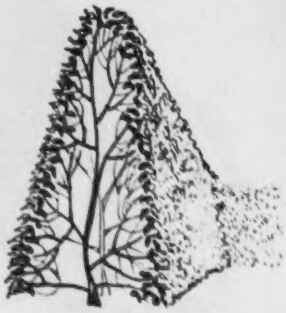
1. Topiary
2. Espalier
3. Hedge

2. Identify hedge shapes seen in the illustrations below. Write the correct names in the blanks.

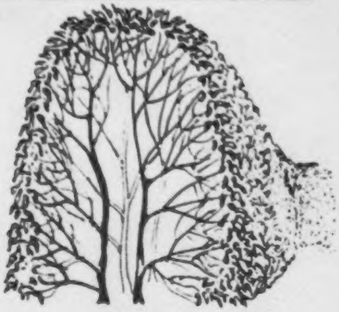
Informal
Loaf shaped
Elongated pyramid
Oblong



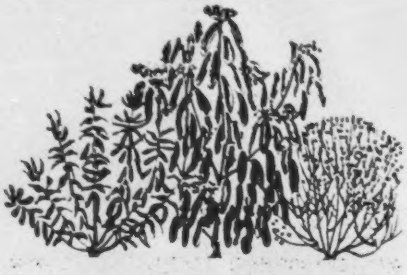
a. ______________________________



b. ______________________________

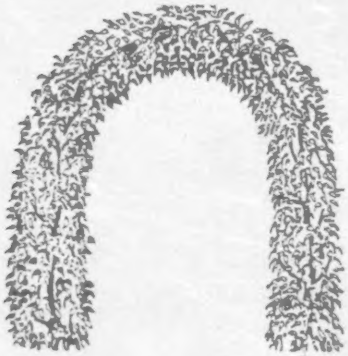


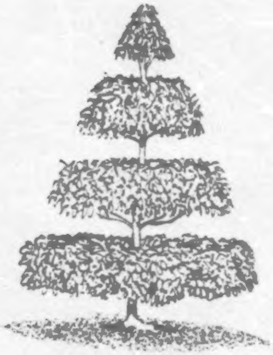
c. ______________________________



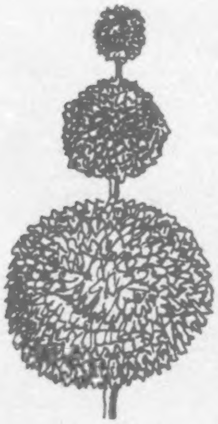
d. ______________________________

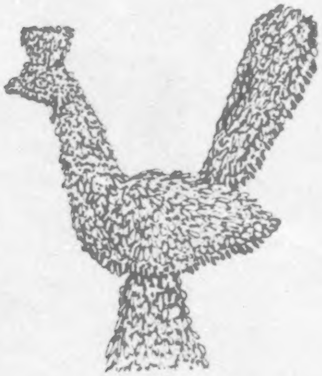
3. Label common topiary shapes shown below. Write the correct names in the blanks.





a. ______________________ b. ______________________





c. ______________________ d. ______________________

4. List plants grown as topiary.

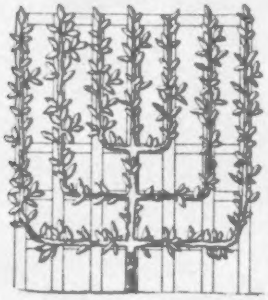
a. ______________________

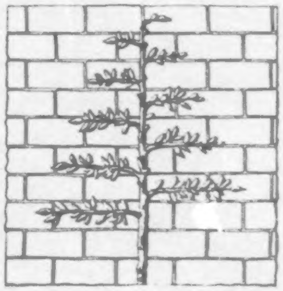
b. ______________________

c. ______________________

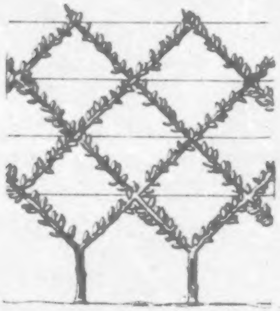
d. ______________________

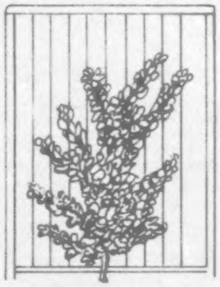
5. Label common espalier shapes shown below. Write the correct names in the blanks.





a. ____________________ b. ____________________





c. ____________________ d. ____________________

6. List plants grown espalier.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

7. Demonstrate the ability to:

a. Trim a hedge.

b. Train plant material to an espalier.

(NOTE: If the above activities have not been finished before the test, ask your instructor when they should be completed.)

SPECIAL PURPOSE PRUNING AND TRAINING
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 3
   c. 1
2. a. Oblong
   b. Elongated pyramid
   c. Loaf shaped
   d. Informal
3. a. Archway
   b. Interrupted cone
   c. Graduated spheres
   d. Novelty shape
4. a. Boxwood
   b. Yew
   c. Arborvitae
   d. Junipers
5. a. Candelabra
   b. Tiers
   c. Diamond pattern
   d. Free-form
6. a. English ivy
   b. Pyracantha
   c. Fruit trees
   d. Vining roses
7. Performance skills evaluated to satisfaction of instructor

PLANT IDENTIFICATION
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify plants by structural features. This knowledge will be shown by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with plant identification to the correct definitions.
2. List plant features used for identification.
3. Match terms associated with parts of a leaf to the correct definitions.
4. Label types of leaves.
5. List common leaf arrangements.
6. Match types of inflorescences (flowers) to the correct definitions.
7. Identify plant forms.
8. List vine appendages (specialized plant parts).
9. Arrange in order steps in botanical naming.
10. Identify leaf characteristics.
11. Identify types of inflorescences.
12. Record plant identification information.
13. Trace a plant from kingdom to genus and species.

PLANT IDENTIFICATION
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor:

  A. Provide student with objective sheet.

  B. Provide student with information and assignment sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information sheet.

  E. Take a field trip and demonstrate plant identification procedures.

  F. Select plant materials for assignment sheets.

  G. Give test.

  H. Reteach if necessary.

II. Instructional materials:

  A. Objective sheet

  B. Information sheet

  C. Assignment sheets

    1. Assignment Sheet #1--Identify Leaf Characteristics

    2. Assignment Sheet #2--Identify Types of Inflorescences

    3. Assignment Sheet #3--Record Plant Identification Information

    4. Assignment Sheet #4--Trace a Plant from Kingdom to Genus and Species

III. Unit references:

  A. Waterfall, U.T. *Keys to the Flora of Oklahoma*. 5th ed. Stillwater, OK: Published by author, 1972 (for sale in Student Union Bookstore, Oklahoma State University.)

  B. *Plant Science, Landscape Plant and Herbarium Card Reference*, 4-H Leader's Guide, Cooperative Extension Service, Oklahoma State University, 1980.

  C. Whitcomb, Carl E. *Know It and Grow It*. Tulsa: Oil Capital Printing. 1975.

PLANT IDENTIFICATION
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Lenticels--Breathing structures found on the stem; may be corky

      (NOTE: They may go around, run parallel, or be scattered on the stem.)

   B. Simple leaf--Leaf which is one solid piece; undivided

   C. Pinnately compound--Leaf with leaflets arranged opposite each other along the rachis

      Example: Pecan

   D. Rachis--Central stem found in flower clusters or compound leaves

   E. Bi-pinnately compound (twice pinnate)--Leaf which has leaflets which are also compound or divided

      Example: Mimosa

   F. Palmately compound--Leaf divided into sections so that it appears like fingers on a hand

      Example: Texas buckeye

   G. Opposite--Directly across from each other

      Example: Dogwood

   H. Alternate--Found at different levels along a stem

      Example: Hollies

   I. Whorled--Cyclic leaf arrangement; more than two leaves attached at the same point

   J. Genus--Family name for a group of genetically similar plants

   K. Species--Specific name of a plant

   L. Cultivar--Plant selection which is usually produced asexually or through controlled breeding

II. Plant features used for identification

   A. Flowers

   B. Fruits

   C. Leaves

   D. Stems

INFORMATION SHEET

E. Bark

(NOTE: Presence and shape of lenticels is a common method of bark identification.)

F. Form

III. Parts of a leaf

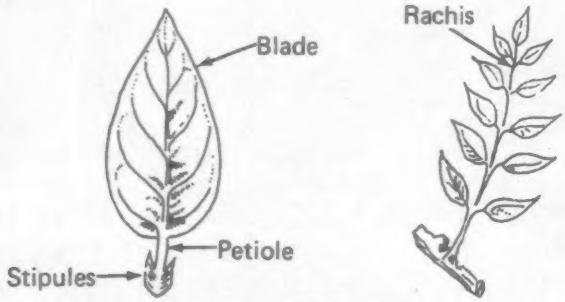
A. Stipules--Secondary growth at the base of a petiole

B. Petiole--Stalk at the base of a leaf (leaf stem)

C. Blade--Expanded, flattened portion of a leaf, attached to the petiole

D. Rachis--Central stem of compound leaves

Examples:



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IV. Types of leaves

A. Simple

Examples: Elm, hackberry

B. Pinnately compound

Examples: Pecan, walnut

C. Bi-pinnately compound

Example: Kentucky coffee tree

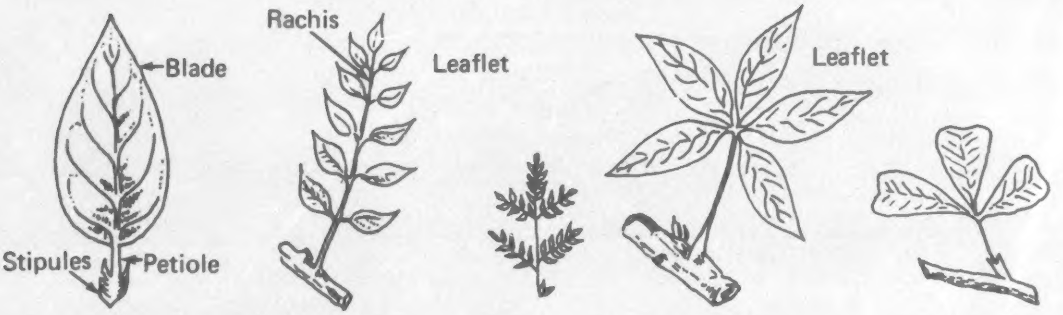
D. Palmately compound

Examples: Buckeye, Virginia creeper

INFORMATION SHEET

E. Trifolate

Examples: Poison ivy, winter jasmine



Simple leaf — Pinnately Compound Leaf — Bi-Pinnately Compound Leaf — Palmately Compound Leaf — Trifoliate Leaf

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V. Common leaf arrangements

A. Opposite

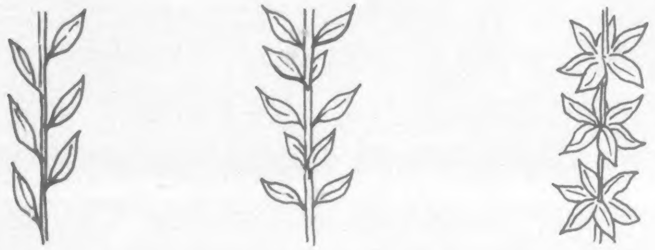
Example: Dogwood, maples

B. Alternate

Example: Hollies

C. Whorled

Example: Yucca, palms



Alternate — Opposite — Whorled

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INFORMATION SHEET

VI. Types of inflorescences (flowers)

A. Single--One flower per stem

Example: Carnation

B. Head--Several flowers clustered on one stem

Example: Chrysanthemum

C. Umbel--Flower cluster with flowers on individual stalks arising from one point

Examples: Barberry, spirea

D. Spike--Bloom with flowers directly attached down a portion of the stem

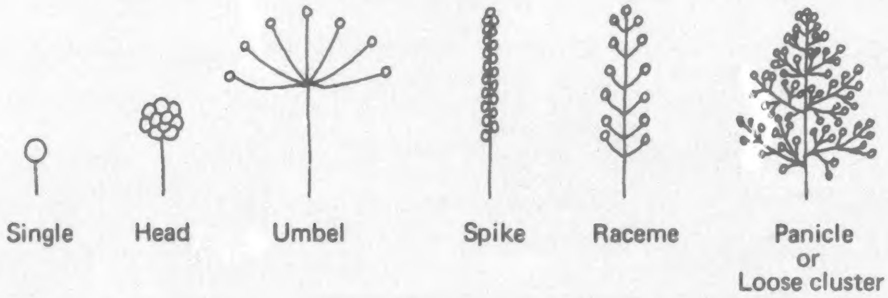
Examples: Gladiolus, monkey grass

E. Raceme--Flowers are borne on stalks attached down a length of stem

Examples: Delphinium, wisteria

F. Panicle--A branched cluster of flowers

Examples: Lilac, smoketree



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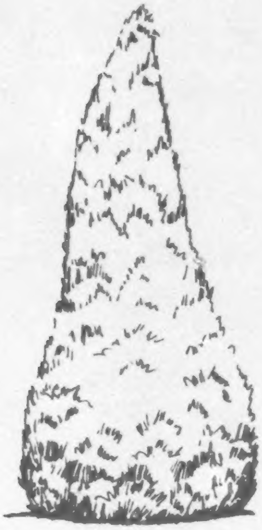
INFORMATION SHEET

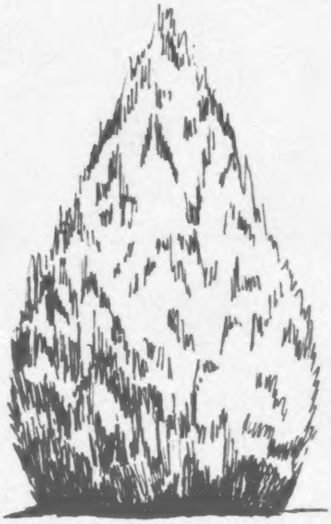
VII. Plant forms

A. Narrowleaf evergreens

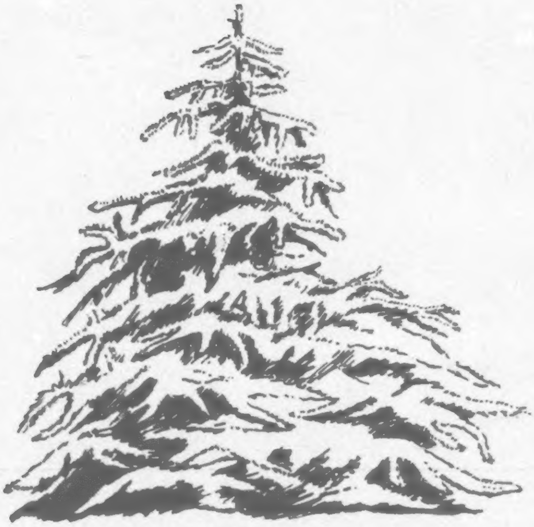
1. Upright, sheared



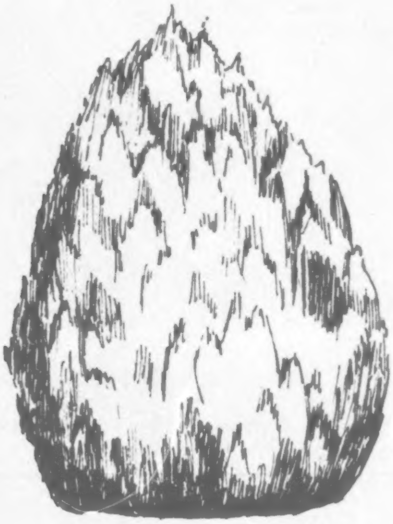
2. Upright, natural



3. Upright, conical, central leader

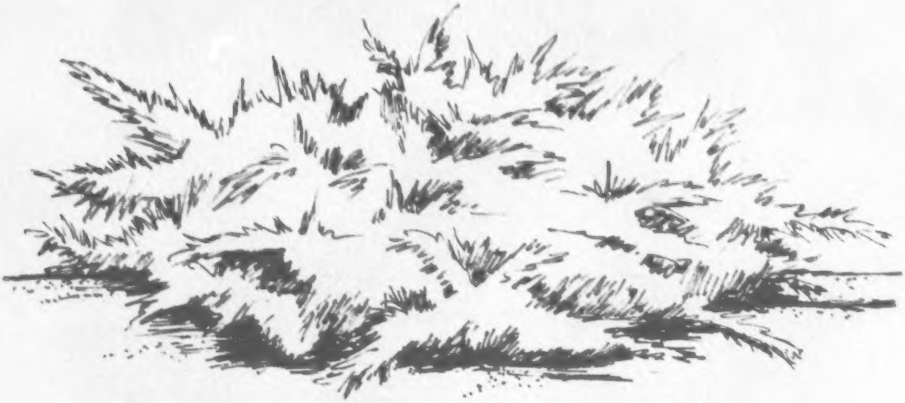


4. Upright, semiconical, multiple trunk



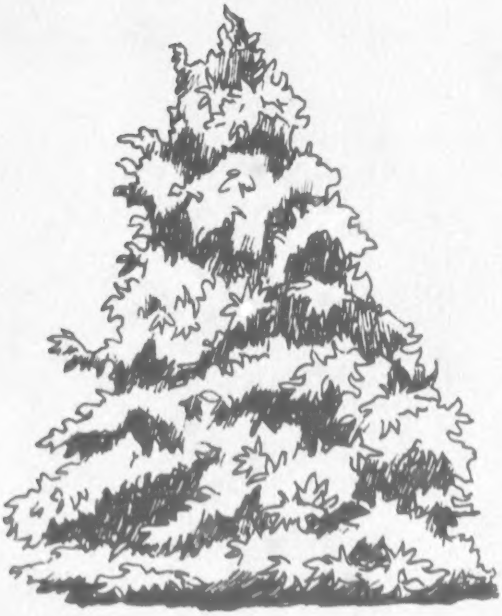
INFORMATION SHEET

5. Low, spreading

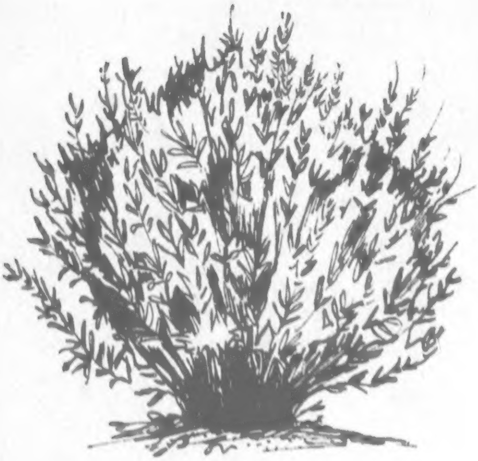


B. Broadleaf evergreens

1. Upright, conical, central leader

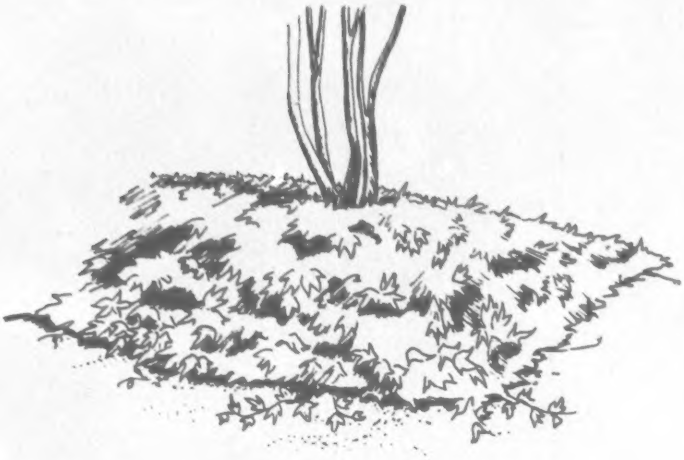


2. Upright, semiconical, multiple trunk



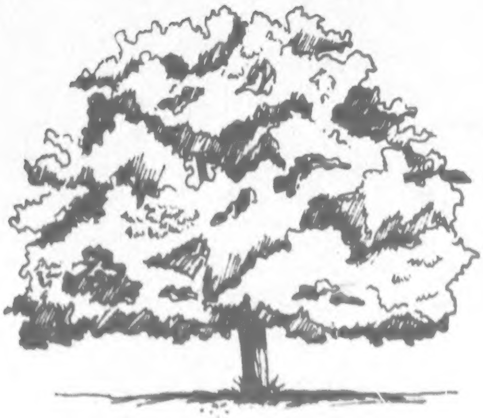
INFORMATION SHEET

3. Creeping

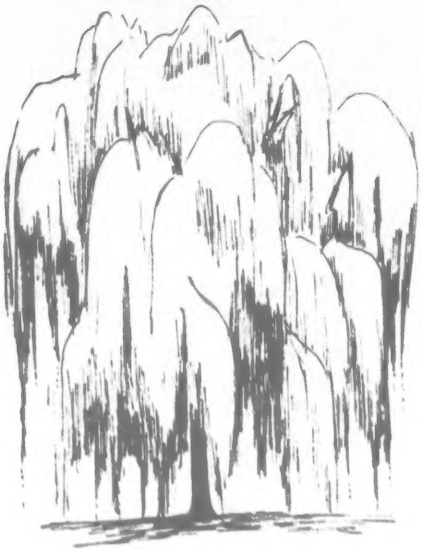


C. Deciduous

1. Canopy

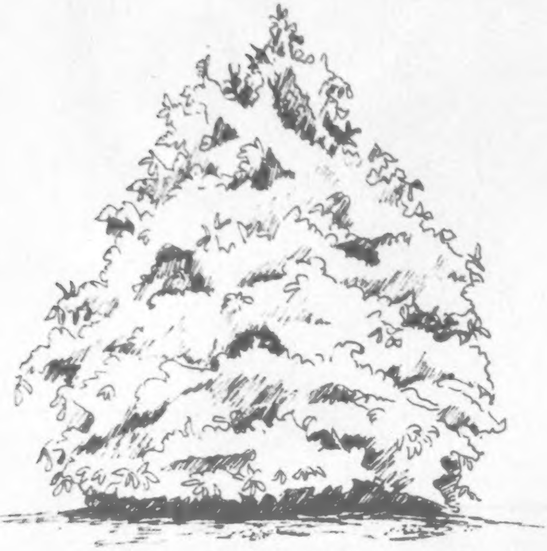


2. Weeping

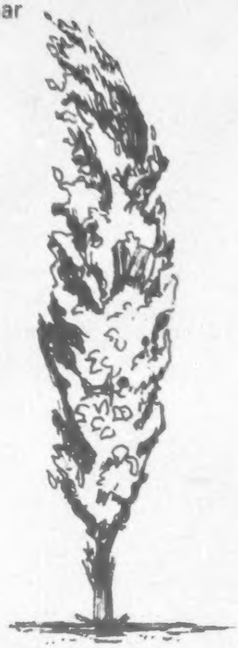


INFORMATION SHEET

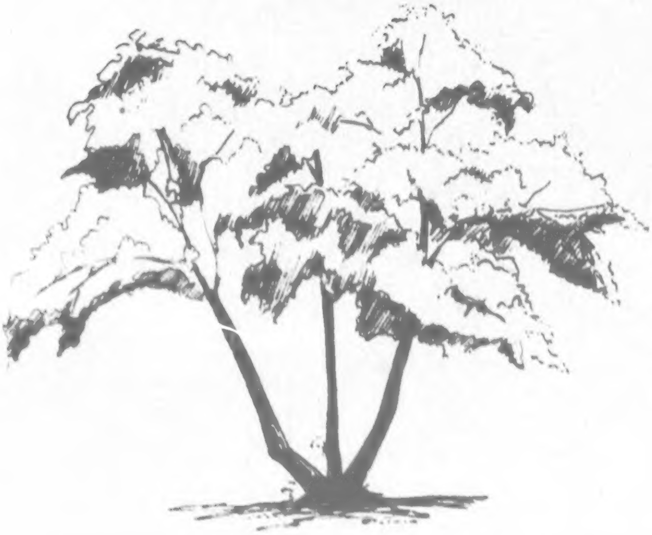
3. Pyramid or conical with a central leader



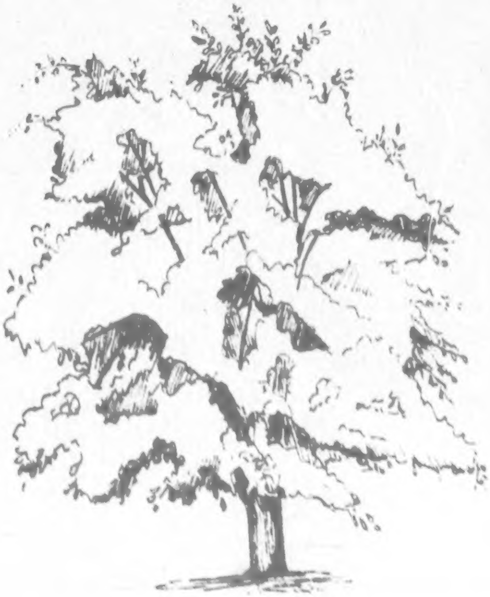
4. Columnar



5. Multiple trunk



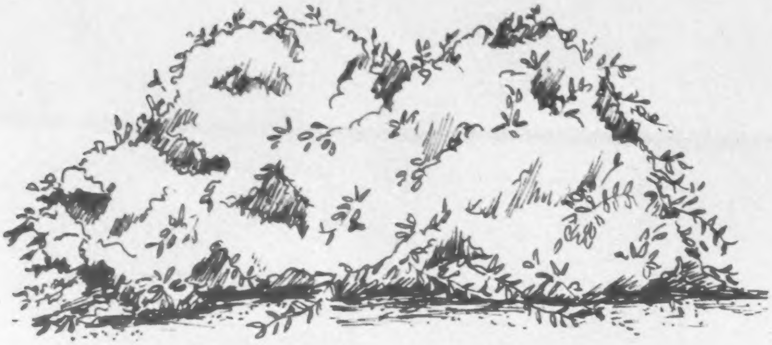
6. Irregular form



INFORMATION SHEET

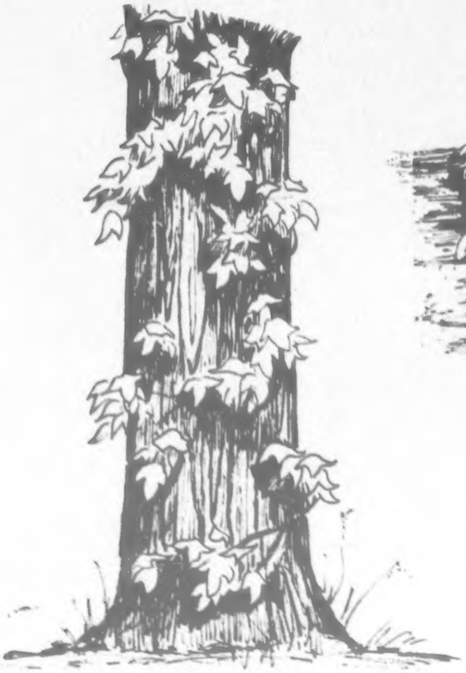
7. Low, spreading

(NOTE: Deciduous shrubs have many forms and do not fall into specific categories. Identification can still be made using other characteristics.)

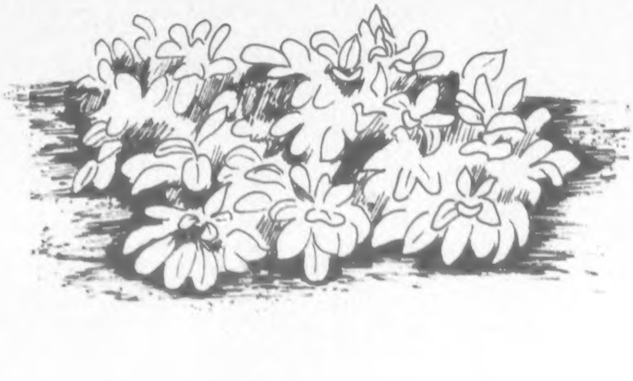


D. Vines and ground covers

1. Vine



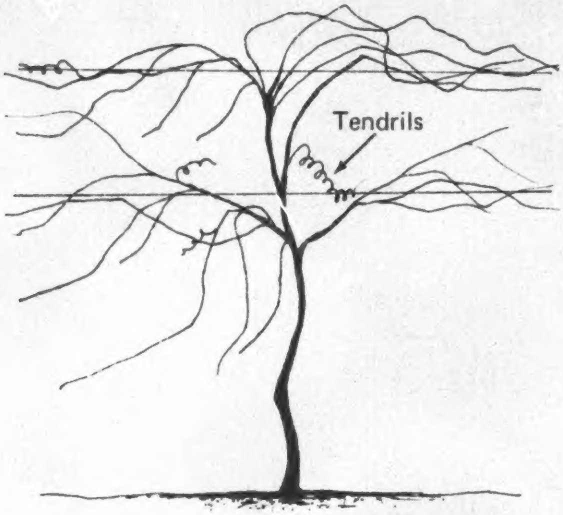
2. Ground cover



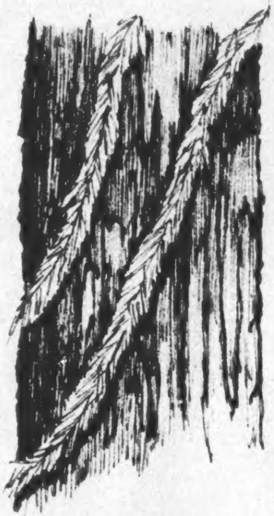
INFORMATION SHEET

VIII. Vine appendages (specialized plant parts)

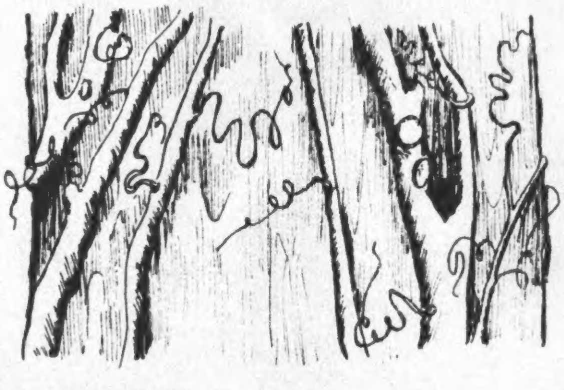
A. Tendrils



B. Aerial roots



C. Disc tendrils



INFORMATION SHEET

IX. Steps in botanical naming

A. Kingdom

Example: Planta

B. Division

Example: Angiospermae

C. Subdivision

Example: Dicotoledonae

D. Order

Example: Rosales

E. Family

Example: Rosaceae

F. Genus

Example: Rosa

G. Species

Example: Speciosa

(NOTE: Species names are rarely capitalized unless taken from a proper noun which is the name of a person.)

PLANT IDENTIFICATION
UNIT I

ASSIGNMENT SHEET #1-IDENTIFY LEAF CHARACTERISTICS

NAME______________________________ SCORE______________

In many fields of horticulture you will need to be able to identify plants by common characteristics. Fill out the chart on the next page from materials provided by your instructor.

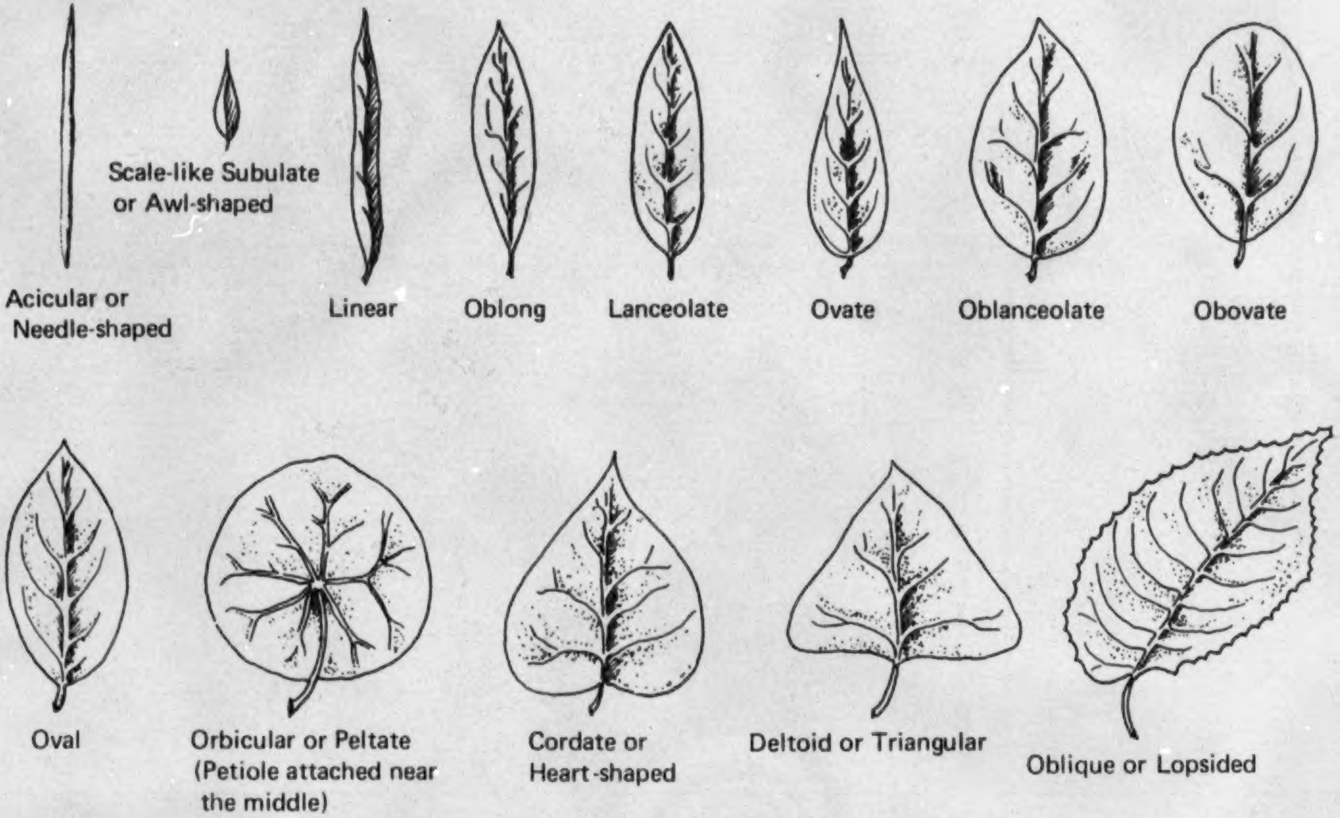
Use the reference sheets which follow to help you fill in the chart.

ASSIGNMENT SHEET #1

Type of Leaf	Leaf Shape	Leaf Margin	Leaf Tip	Leaf Arrangement	Venation Pattern	Common names if known	Comments

ASSIGNMENT SHEET #1

COMMON LEAF SHAPES


Acicular or Needle-shaped
Scale-like Subulate or Awl-shaped
Linear
Oblong
Lanceolate
Ovate
Oblanceolate
Obovate
Oval
Orbicular or Peltate (Petiole attached near the middle)
Cordate or Heart-shaped
Deltoid or Triangular
Oblique or Lopsided

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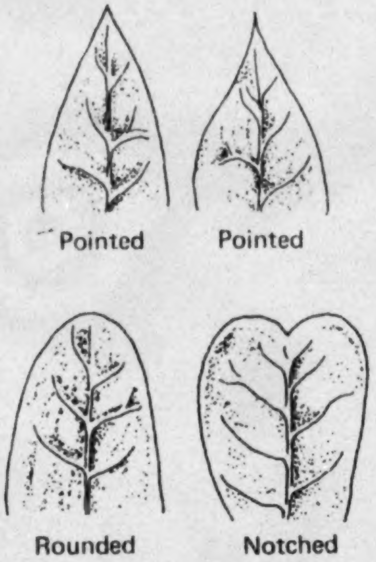
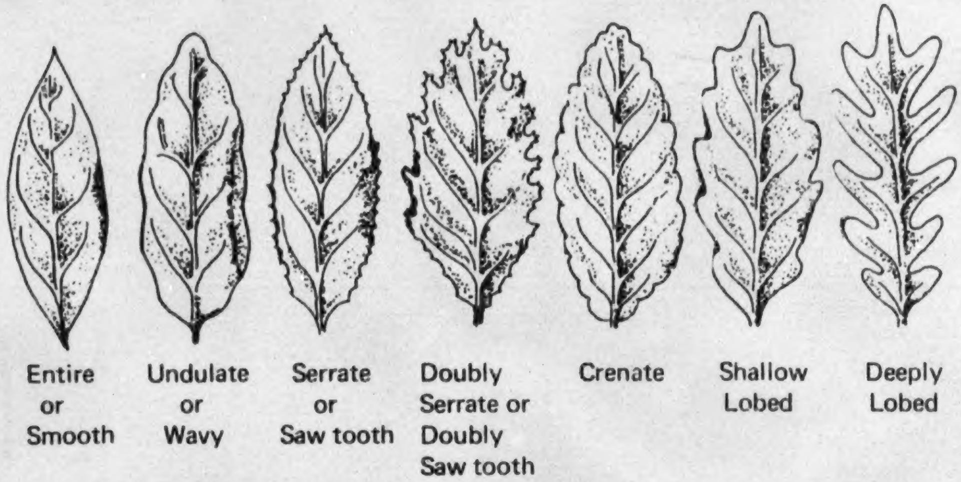
ASSIGNMENT SHEET #1

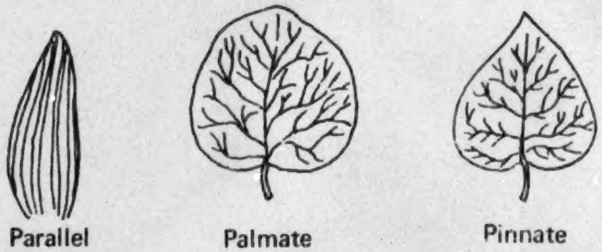
Leaf tips


Pointed
Pointed
Rounded
Notched

Leaf margins


Entire or Smooth
Undulate or Wavy
Serrate or Saw tooth
Doubly Serrate or Doubly Saw tooth
Crenate
Shallow Lobed
Deeply Lobed

Leaf venation


Parallel
Palmate
Pinnate

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PLANT IDENTIFICATION
UNIT I

ASSIGNMENT SHEET #2–IDENTIFY TYPES OF INFLORESCENCES

NAME____ SCORE__________

Identify types of inflorescences from samples provided by your instructor. Fill out the following chart.

Plant name (if known)	Flower arrangement	Color	Comments

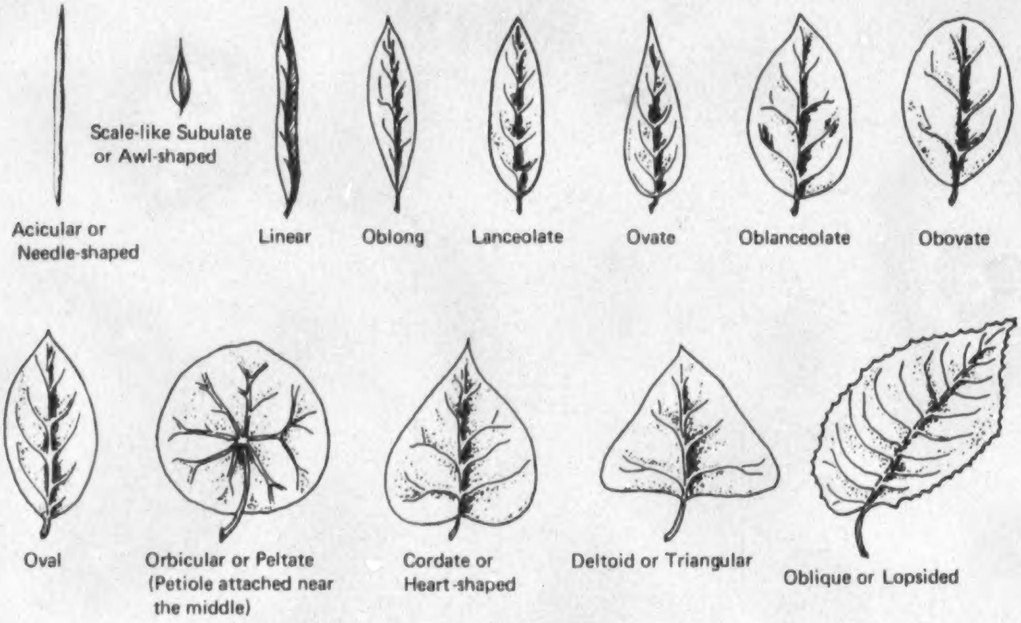
PLANT IDENTIFICATION
UNIT I

ASSIGNMENT SHEET #3--RECORD PLANT IDENTIFICATION INFORMATION

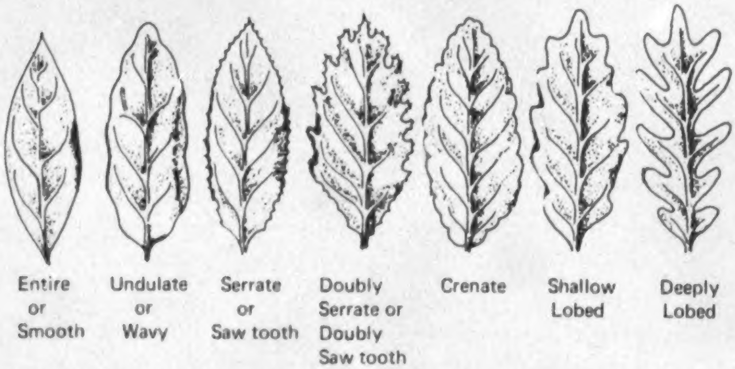
NAME____ SCORE____________

Fill in the following chart for the plants chosen by your instructor. Use the following illustrations for reference if necessary.

COMMON LEAF SHAPES


Acicular or Needle-shaped
Scale-like Subulate or Awl-shaped
Linear
Oblong
Lanceolate
Ovate
Oblanceolate
Obovate
Oval
Orbicular or Peltate (Petiole attached near the middle)
Cordate or Heart-shaped
Deltoid or Triangular
Oblique or Lopsided

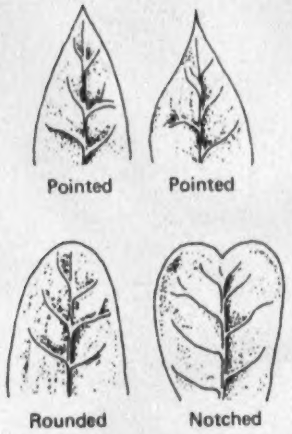
Leaf margins


Entire or Smooth
Undulate or Wavy
Serrate or Saw tooth
Doubly Serrate or Doubly Saw tooth
Crenate
Shallow Lobed
Deeply Lobed

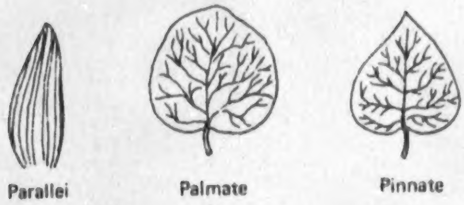
Used with permission of Dr. Carl E. Whitcomb from *Know It and Grow It*, copyright 1975.

ASSIGNMENT SHEET #3

Leaf tips


Pointed
Pointed
Rounded
Notched

Leaf venation


Parallel
Palmate
Pinnate

Used with permission of Dr. Carl E. Whitcomb from *Know It and Grow It*, copyright 1975.

ASSIGNMENT SHEET #3

Plant Form	Type of Leaf	Leaf Margin	Venation Tip	Leaf Arrangement	Flower Color if present	Bark Color	Seed description if present

PLANT IDENTIFICATION
UNIT I

ASSIGNMENT SHEET #4--TRACE A PLANT FROM KINGDOM TO GENUS AND SPECIES

NAME________________________________ SCORE______________

Using reference books, trace a plant through all the steps in botanical naming.

A. Kingdom:

B. Division:

C. Subdivision:

D. Order:

E. Family:

F. Genus:

G. Species:

PLANT IDENTIFICATION
UNIT I

TEST

NAME ______________________________ SCORE __________

1. Match terms associated with plant identification to the correct definitions. Write the correct numbers in the blanks.

______a. Leaf which is one solid piece; undivided

______b. Central stem found in flower clusters or compound leaves

______c. Leaf divided into sections so that it appears like fingers on a hand

______d. Found at different levels along a stem

______e. Family name for a group of genetically similar plants

______f. Plant selection which is usually produced asexually or through controlled breeding

______g. Breathing structures found on the stem; may be corky

______h. Leaf with leaflets arranged opposite each other along the rachis

______i. Leaf which has leaflets which are also compound or divided

______j. Directly across from each other

______k. Cyclic leaf arrangement; more than two leaves attached at the same point

______l. Specific name of a plant

1. Simple leaf
2. Genus
3. Cultivar
4. Pinnately compound
5. Bi-pinnately compound (twice pinnate)
6. Palmately compound
7. Alternate
8. Species
9. Opposite
10. Lenticels
11. Rachis
12. Whorled

2. List plant features used for identification.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

3. Match terms associated with parts of a leaf to the correct definitions. Write the correct names in the blanks.

______a. Central stem of compound leaves

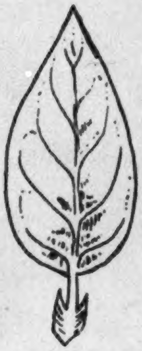
______b. Expanded, flattened portion of a leaf, attached to the petiole

______c. Secondary growth at the base of a petiole

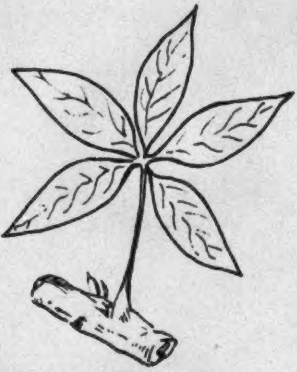
______d. Stalk at the base of a leaf (leaf stem)

1. Stipules
2. Petiole
3. Blade
4. Rachis

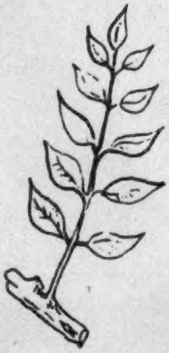
4. Label types of leaves. Write the correct names in the blanks.



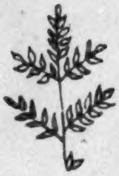
a. ______________



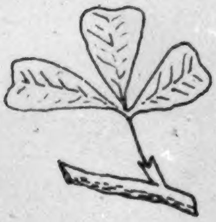
b. ______________



c. ______________



d. ______________



e. ______________

5. List common leaf arrangements in the blanks below.

a. ____________________

b. ____________________

c. ____________________

6. Match types of inflorescences (flowers) to the correct definitions. Write the correct names in the blanks.

_____a. Flowers are borne on stalks attached down a length of stem

_____b. One flower per stem

_____c. Several flowers clustered on one stem

_____d. Bloom with flowers directly attached down a portion of the stem

_____e. Flower cluster with flowers on individual stalks arising from one point

_____f. A branched cluster of flowers

1. Panicle
2. Single
3. Head
4. Raceme
5. Spike
6. Umbel

7. Identify plant forms seen in the illustrations on the next pages. Write the correct names in the blanks.

Upright, conical, central leader, narrowleaf evergreen

Upright, semiconical, multiple trunk, narrowleaf evergreen

Low, spreading narrowleaf evergreen

Creeping broadleaf evergreen

Canopy deciduous

Weeping deciduous

Pyramid or conical deciduous with a central leader

Columnar deciduous

Multiple trunk deciduous

Irregular form deciduous

Low, spreading deciduous

Upright, sheared narrowleaf evergreen

Upright, natural narrowleaf evergreen

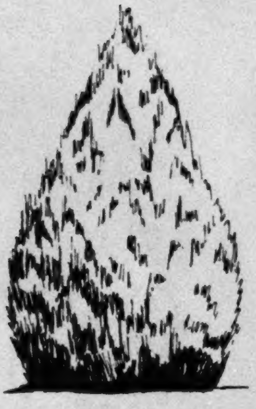
Upright, conical, central leader, broadleaf evergreen

Upright semiconical, multiple trunk, broadleaf evergreen

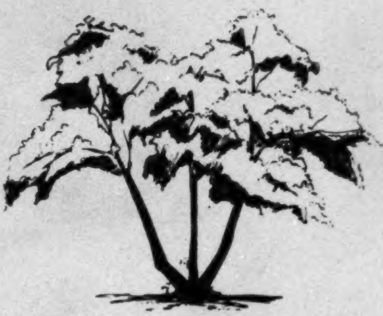
Creeping broadleaf evergreen

Vines

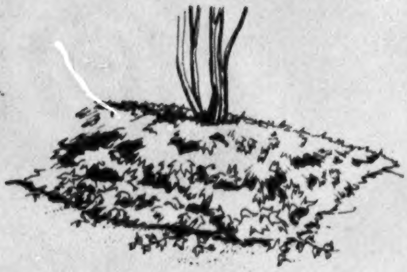
Ground cover



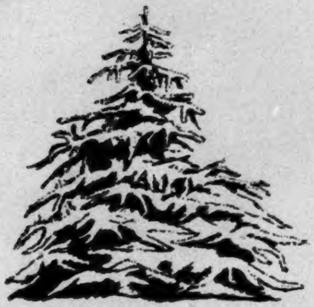
a. ____________



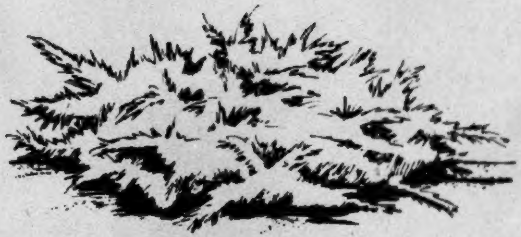
b. ____________



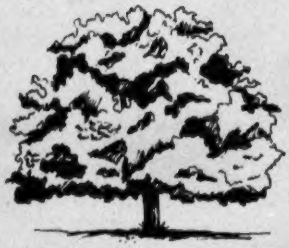
c. ____________



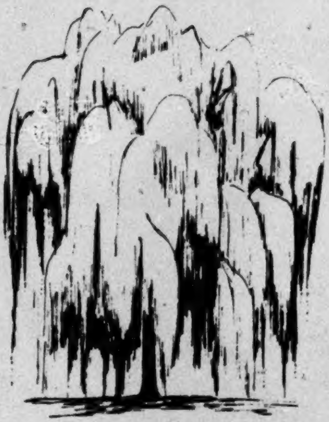
d. ____________



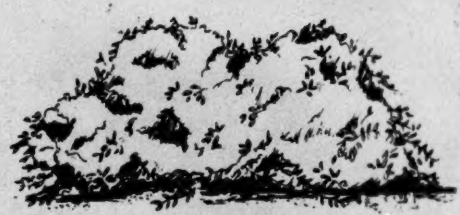
e. ____________



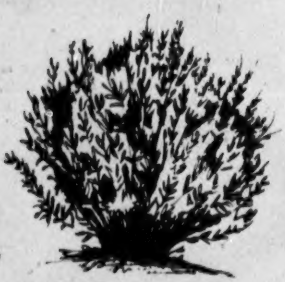
f. ____________



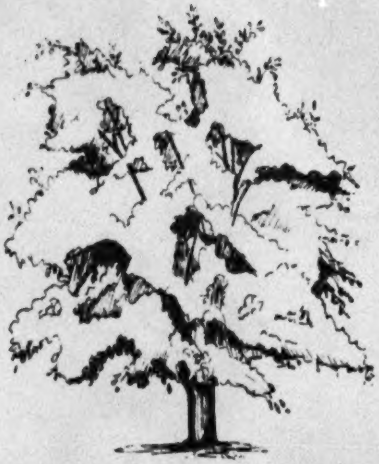
g. ____________



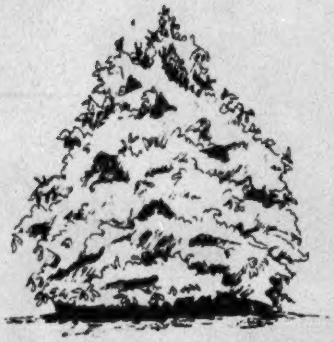
h. ____________



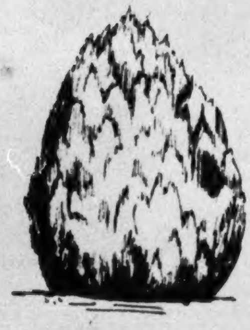
i. ____________



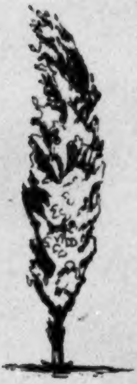
j. ____________



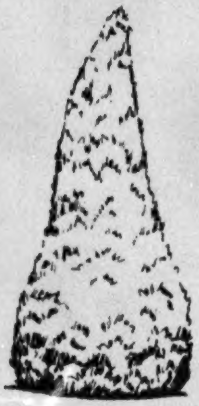
k. ____________



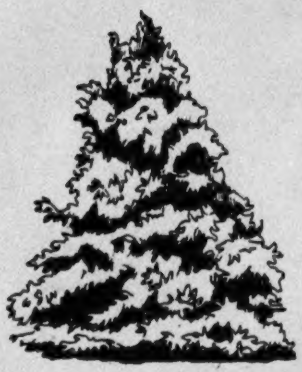
l. ____________



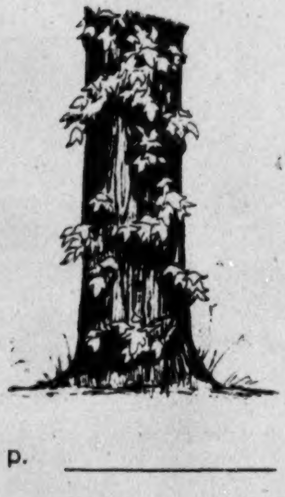
m. ____________



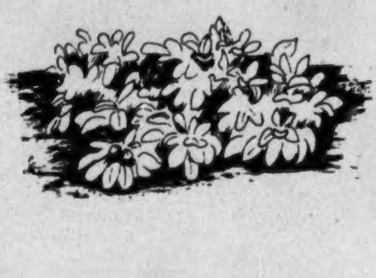
n. ____________



o. ____________



p. ____________



q. ____________

8. List vine appendages (specialized plant parts).

   a. ______________________________

   b. ______________________________

   c. ______________________________

9. Arrange in order steps in botanical naming. Write a "1" by the first step, a "2" by the second step, and so on through step 7.

   _____a. Species

   _____b. Subdivision

   _____c. Genus

   _____d. Division

   _____e. Kingdom

   _____f. Family

   _____g. Order

10. Identify leaf characteristics.

11. Identify types of inflorescences.

12. Record plant identification information.

13. Trace a plant from kingdom to genus and species.

    (NOTE: If activities 10-13 have not been finished before the test, ask your instructor when they should be completed.)

PLANT IDENTIFICATION
UNIT I

ANSWERS TO TEST

1. a. 1
   b. 11
   c. 6
   d. 7
   e. 2
   f. 3
   g. 10
   h. 4
   i. 5
   j. 9
   k. 12
   l. 8
2. a. Flowers
   b. Fruits
   c. Leaves
   d. Stems
   e. Bark
   f. Form
3. a. 4
   b. 3
   c. 1
   d. 2
4. a. Simple
   b. Palmately compound
   c. Pinnately compound
   d. Bi-pinnately compound
   e. Trifoliate
5. a. Alternate
   b. Opposite
   c. Whorled

6. a. 4
   b. 2
   c. 3
   d. 5
   e. 6
   f. 1

7. a. Upright, natural narrowleaf evergreen
   b. Multiple trunk deciduous
   c. Creeping broadleaf evergreen
   d. Upright, conical, central leader, narrowleaf evergreen
   e. Low, spreading narrowleaf evergreen
   f. Canopy deciduous
   g. Weeping deciduous
   h. Low, spreading deciduous
   i. Upright, semiconical, multiple trunk, broadleaf evergreen
   j. Irregular form deciduous
   k. Pyramid or conical deciduous with a central leader
   l. Upright, semiconical, multiple trunk, narrowleaf evergreen
   m. Columnar deciduous
   n. Upright, sheared narrowleaf evergreen
   o. Upright, conical, central leader, broadleaf evergreen
   p. Vines
   q. Ground cover

8. a. Tendrils
   b. Aerial roots
   c. Disc tendrils

9. a. 7
   b. 3
   c. 6
   d. 2
   e. 1
   f. 5
   g. 4
10. Evaluated to satisfaction of instructor
11. Evaluated to satisfaction of instructor
12. Evaluated to satisfaction of instructor
13. Evaluated to satisfaction of instructor

TRANSPLANTING
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to demonstrate several transplanting procedures. This knowledge will be evidenced by completion of the job sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to:

1. Match terms associated with transplanting to the correct definitions.
2. List types of transplanting.
3. Select from a list true statements about transplanting seedlings.
4. Arrange in order steps in transplanting rooted cuttings.
5. Select from a list true statements about transplanting bare-root stock.
6. List advantages and disadvantages of ball and burlap method compared with bare-root method.
7. List factors that affect use of ball and burlap method.
8. List the steps in determining ball size.
9. Select from a list true statements about transplanting ball and burlap stock.
10. Select from a list true statements about transplanting container stock.
11. Demonstrate the ability to:
    a. Ball and burlap a tree or shrub.
    b. Transplant seedlings.
    c. Transplant a bare-root tree or shrub.
    d. Transplant container stock.

TRANSPLANTING
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

  A. Provide student with objective sheet.

  B. Provide student with information and job sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information sheet.

  E. Visit local nurseries or garden centers to see different types of transplants.

  F. Collect equipment needed for job sheets.

  G. Demonstrate and discuss procedures outlined in job sheets.

  H. Give test.

  I. Reteach if necessary.

II. Instructional materials

  A. Objective sheet

  B. Information sheet

  C. Job sheets

    1. Job Sheet #1--Ball and Burlap a Tree or Shrub

    2. Job Sheet #2--Transplant Seedlings

    3. Job Sheet #3--Transplant a Bare-Root Tree or Shrub

    4. Job Sheet #4--Transplant Container Stock

  D. Test

  E. Answers to test

III. Unit references

  A. Denisen, Ervin L., *Principles of Horticulture*. New York: Macmillan Publishing Co., Inc., 1958.

  B. Murphy, Richard C., and Meyer, William E. *The Care and Feeding of Trees*, 2nd ed. New York: Crown Publishers, Inc., 1969.

  C. Bienz, D.R. *The Why and How of Home Horticulture*. San Francisco: W.H. Freeman and Company, 1980.

TRANSPLANTING
UNIT I

INFORMATION SHEET

I. Terms and definitions

  A. Bare-root--Tree or shrub for transplanting that has little or no soil around the roots

  B. Ball and burlap--Tree or shrub with an undisturbed mass of soil remaining on the roots; wrapped in sacking and/or a wire basket

  C. Container stock--Landscape plant materials grown in some type of container

  D. Damping-off--Rotting of seedlings or cuttings caused by fungi; stem is attacked near soil line, causing plant to fall over

  E. Caliper--Measure of stem or trunk diameter or thickness

  F. Sunscald--Injury or death of bark due to too-strong light

II. Types of transplanting

  A. Seedlings

  B. Rooted cuttings

  C. Bare-root

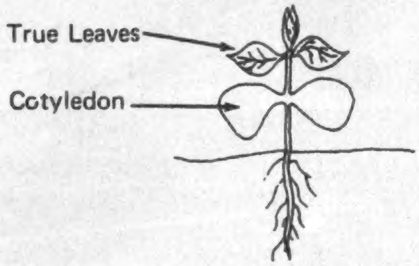
  D. Ball and burlap

  E. Container stock

III. Transplanting seedlings

  A. Two true leaves on dicots should be present at time of transplanting

  (NOTE: Most monocots are planted directly and do not require transplanting.)



INFORMATION SHEET

B. Dicot seedlings must be handled carefully by the cotyledons

C. Hole should be formed in soil with finger, dibble, pencil, or some other instrument

D. Soil surrounding seedling should be carefully loosened to avoid injury

(NOTE: Slightly dry soil makes removal easier.)

E. All roots should be placed in hole

F. Soil should be firmed around seedling

G. Seedlings should always be watered in thoroughly

H. Recommended fungicide should be applied to soil to avoid damping-off

IV. Transplanting rooted cuttings

A. Prepare pot or soil by digging a hole slightly larger than root ball

B. Remove cutting from rooting medium or small pot, leaving some soil in place around roots

C. Place cutting in prepared hole

D. Gently firm soil in place around cutting

E. Water in, allowing soil to settle

F. Add additional soil as needed

V. Transplanting bare-root stock

A. Usually done on trees and shrubs

B. Transplant is usually packed in damp peat to keep roots from drying out

C. Hole dug should be 5-7 inches wider all the way around than the root span

(NOTE: You may want to form a small cone in the hole to make planting easier.)

D. Roots should be spread as they normally grow

(NOTE: Special care should be taken not to curl roots around the hole as this can eventually girdle the plant.)

INFORMATION SHEET

VI. Ball and burlap method

A. Advantages

1. Offers roots more protection than bare-root plants
2. Can be done on extremely large trees, whereas bare-root can be done only on smaller plants
3. Less time-consuming than bare-root in transplanting

B. Disadvantages

1. More time-consuming than bare-root in digging process
2. Must use nails, twine, wire baskets, or some other material to contain soil ball

VII. Factors that affect use of ball and burlap method

A. Time of year

B. Soil moisture

C. Temperature

VIII. Determining ball size

A. Measure stem caliper 12 inches above soil line

B. Multiply stem caliper by 10 inches and 12 inches for range of soil ball diameter

Example: For a tree with a 4 inch caliper

4 x 10 = 40 40-48 inch soil ball
4 x 12 = 48

C. Depth of ball is 1/2 to 2/3 diameter of soil ball

Example: 48 inch diameter

48 x 1/2 = 24 inches deep to
48 x 2/3 = 32 inches deep

IX. Transplanting ball and burlap stock

A. Hole should be dug slightly deeper than the height of the soil ball

(NOTE: Crown of plant should be at soil level after transplanting.)

B. Hole should be dug approximately 1 foot larger than the ball all the way around

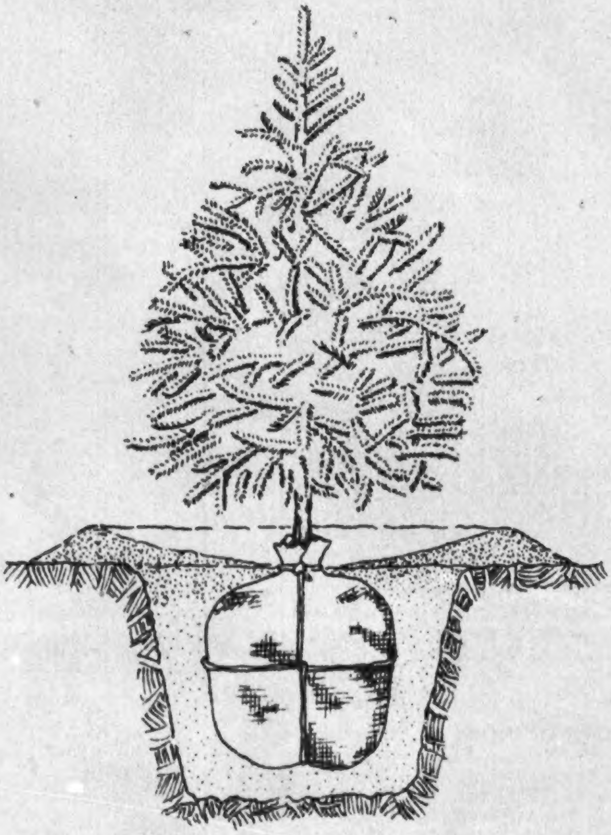
INFORMATION SHEET

C. Place ball and burlap stock in hole, removing any ties or twine, wire baskets, or wire

(NOTE: Burlap may be loosened and allowed to rot.)

D. Water in by placing hose at bottom of hole, allowing water to be absorbed and soil to settle

E. Form a reservoir around tree to retain water



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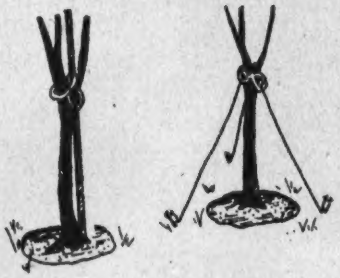
INFORMATION SHEET

F. Stake for wind protection by using rubber hose, wires, and stakes, or some other approved securing method

(NOTE: There are many methods of staking trees. The combination listed above is commonly used.)



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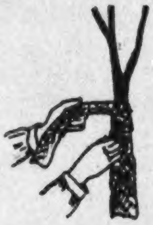
G. Wrap trunk with burlap, cheesecloth, or specially designed tree wrap material to prevent sunscald



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X. Transplanting container stock

A. Can be performed at any time, so can be allowed to bloom; color of bloom is known

B. Less expensive to produce than ball and burlap stock

C. Transplanting may be more difficult since can must be removed

D. Transporting container stock is easier than transporting ball and burlap or bare-root stock

E. Biggest is not best; select plants in proportion to the container

F. Does not require immediate planting

TRANSPLANTING
UNIT I

JOB SHEET #1--BALL AND BURLAP A TREE OR SHRUB

I. Tools and equipment

- A. Tree or shrub
- B. Nursery balling spade or shovel
- C. Burlap
- D. Nursery balling nails
- E. Caliper
- F. Twine

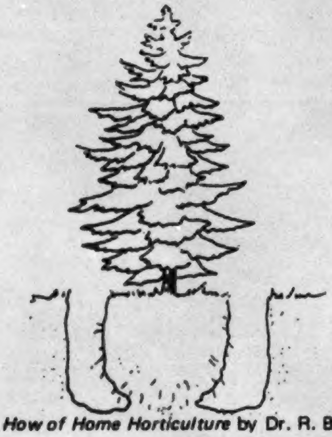
II. Procedure

- A. Measure stem caliper twelve inches above soil line
- B. Determine ball size needed
- C. Trace ball diameter on soil surface to keep correct size
- D. Dig ball by forcing shovel straight down and working out

  (NOTE: Do not work shovel back and forth; ball may be damaged and not hold shape; back of shovel should be toward the ball to prevent the shovel point damaging the ball.)

- E. Increase hole size by trenching around the soil ball 2/3 to 1/2 as deep as the ball is wide; do this all the way around the tree (Figure 1)

FIGURE 1

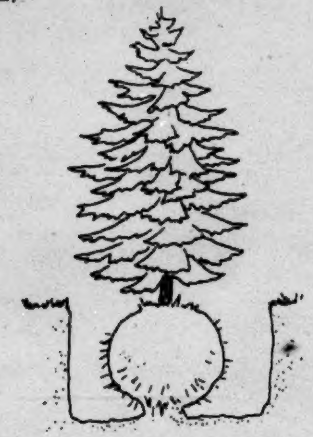


From *The Why and How of Home Horticulture* by Dr. R. Bienz. W. H. Freeman and Company. copyright 1980.

JOB SHEET #1

F. Round off the soil ball until only a small part of the underside remains attached (Figure 2)

FIGURE 2



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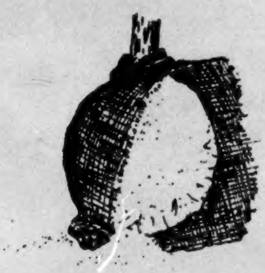
G. Carefully sever the attached area with the shovel

H. Fasten one corner of the sheet of burlap around the trunk with a nail (Figure 3)

FIGURE 3



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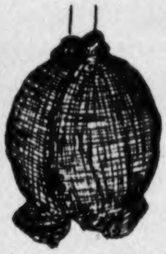
JOB SHEET #1

I. Pull burlap tightly around soil ball, taking up slack burlap with nails (Figure 4)

FIGURE 4



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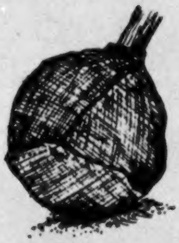
J. Tip plant over gently and pin burlap over exposed soil (Figure 5)

FIGURE 5



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TRANSPLANTING
UNIT I

JOB SHEET #2--TRANSPLANT SEEDLINGS

I. Tools and equipment

- A. Flat containing plants with at least two true leaves
- B. Pots for transplanting
- C. Medium (soil)
- D. Knife or some other tool for loosening rooting medium
- E. Fungicide
- F. Water
- G. Tags

II. Procedure

- A. Fill pots with soil
- B. Using finger, dibble or pencil, make holes larger than seedling root system
- C. Carefully loosen soil around seedling
- D. Carefully remove seedlings one at a time, holding seedling by the cotyledon
- E. Place entire root system within the hole
- F. Firm soil back around stem of the plant
- G. Water in plants
- H. Spray flats with fungicide to prevent damping-off

  Example: Dexon (Lesan) - Benlate solution
- I. Label tag with important information and place in flat
  1. Crop grown
  2. Cultivar name
  3. Date transplanted
  4. Your name

  (NOTE: Tag should be placed in front of row; anything behind and to the right of the tag will be the same cultivar or plant.)

TRANSPLANTING
UNIT I

JOB SHEET #3--TRANSPLANT A BARE-ROOT TREE OR SHRUB

I. Tools and equipment

A. Bare-root tree or shrub

B. Shovel

C. Water hose

D. Staking materials if needed

Examples: Rubber hose sections, guy wires, stakes

II. Procedure

A. Dig hole 5-7 inches larger than the root span all the way around

B. Dig hole deep enough that the plant will be at the same soil level or slightly deeper than originally planted

C. Remove packing material from roots

(NOTE: Do not remove packing material until hole is ready; if roots dry out, death may occur.)

D. Remove dead or damaged roots

E. Spread out roots as much as possible, taking care not to curl roots around the hole

(NOTE: Making a cone of soil in the bottom of the hole may make this step easier.)

F. Fill in hole with good topsoil

(NOTE: Some people prefer to add soil amendments such as peat moss to the soil.)

G. Water slowly and thoroughly by placing hose at bottom of the hole and allowing water to be absorbed while the soil settles

H. Add any additional soil needed

I. Form a reservoir for future watering

J. Stake tree or shrub if necessary

1. Run guy wire through section of rubber hose
2. Wrap hose loosely around trunk
3. Attach wire to stake

JOB SHEET #3

4. Pull wire tight and place in ground

   (NOTE: Eye bolts may be used instead of hose and wire; they can be removed the second year or may be left.)

K. Remove 1/4 to 1/3 of selected branches and damaged or dead wood

TRANSPLANTING
UNIT I

JOB SHEET #4--TRANSPLANT CONTAINER STOCK

I. Tools and equipment

- A. Container-grown tree or shrub
- B. Shovel
- C. Can cutter, if necessary
- D. Water hose
- E. Knife or pruning shears
- F. Staking materials, if needed

  Examples: Rubber hose sections, guy wires, stakes

II. Procedure

- A. Select healthy container stock
- B. Dig hole slightly deeper than the container
- C. Dig hole 2-4 inches wider than the container all the way around
- D. Split can with can cutter unless plant is in a plastic pot

  (NOTE: Be careful not to break the root ball.)
- E. Remove plant, grasping at the base of the trunk
- F. Cut or pull away roots which are matted or curled around the inside of the can
- G. Set the plant in the hole
- H. Fill in hole with soil
- I. Water plant in by placing water hose at bottom of hole to allow water absorption and soil settling
- J. Add any additional soil needed
- K. Form reservoir for future waterings

TRANSPLANTING
UNIT I

TEST

NAME_______________________________________ SCORE__________

1. Match terms associated with transplanting to the correct definitions. Write the correct numbers in the blanks.

_____a. Landscape plant materials grown in some type of container

_____b. Tree or shrub with an undisturbed mass of soil remaining on the roots; wrapped in sacking and/or a wire basket

_____c. Tree or shrub for transplanting that has little or no soil around the roots

_____d. Rotting of seedlings or cuttings caused by fungi; stem is attacked near soil line, causing plant to fall over

_____e. Injury or death of bark due to too-strong light

_____f. Measure of stem or trunk diameter or thickness

1. Bare-root
2. Caliper
3. Damping-off
4. Sunscald
5. Ball and burlap
6. Container stock

2. List types of transplanting.

a. ____

b. ____

c. ____

d. ____

e. ____

3. Select from the following list true statements about transplanting seedlings. Mark each correct answer with an "X."

_____a. Seedlings must be handled carefully by the true leaves

_____b. Transplanting is done when three or four true leaves are present

_____c. Hole should be formed in soil with finger, dibble, pencil, or some other instrument

_____d. Soil surrounding seedling should be carefully loosened to avoid injury

_____e. Remove about half of the roots or whatever doesn't fit in the hole easily _____f. Soil should be firmed around seedling

_____g. Insecticide should be applied

_____h. Seedlings should always be watered in thoroughly

4. Arrange in order steps in transplanting rooted cuttings. Write a "1" for the first step, a "2" for the second step, and so on through number 6.

_____a. Remove cutting from rooting medium or small pot, leaving some soil in place around roots

_____b. Add additional soil as needed

_____c. Water in, allowing soil to settle

_____d. Place cutting in prepared hole

_____e. Gently firm soil in place around cutting

_____f. Prepare pot or soil by digging a hole slightly larger than root ball

5. Select from the following list true statements about transplanting bare-root stock. Mark each correct answer with an "X."

_____a. Transplant is usually packed in damp peat to keep roots from drying out

_____b. Usually done on trees and shrubs

_____c. Hole dug should be 12 inches wider all the way around than the root span

_____d. Roots too long for normal placement should be curled around the edges of the hole

6. List advantages and disadvantages of ball and burlap method compared with bare-root method.

a. Advantages

1) ______________________________

____

2) ______________________________

____

3) ______________________________

____

b. Disadvantages

1) ______________________________

2) ______________________________

7. List factors that affect use of ball and burlap method.

   a. ____________________

   b. ____________________

   c. ____________________

8. List the steps in determining ball size.

   a. ____________________

   b. ____________________

   c. ____________________

9. Select from the following list true statements about transplanting ball and burlap stock. Mark each correct answer with an "X."

   _____a. Hole should be dug slightly deeper than the height of the soil ball

   _____b. Hole should be dug twice as wide as the soil ball all the way around

   _____c. Place ball and burlap stock in hole, leaving ties, twine, wire baskets and/or wire in place to keep the ball together

   _____d. Water in by placing hose at bottom of hole, allowing water to be absorbed and soil to settle

   _____e. Mound the soil around the tree to prevent water from standing, which may cause rot

   _____f. Stake by wrapping heavy wire around the trunk

   _____g. Wrap trunk with burlap, cheesecloth or specially designed tree wrap material to prevent sunscald

10. Select from the following list true statements about transplanting container stock. Mark each correct answer with an "X."

   _____a. Requires immediate planting

   _____b. The larger the container, the better--the plant will become established quicker

   _____c. Can be performed at any time, so can be allowed to bloom; color of bloom is known

   _____d. Transplanting may be more difficult since can must be removed

   _____e. Transporting container stock is more difficult than transporting ball and burlap or bare-root stock

   _____f. Less expensive to produce than ball and burlap stock

11. Demonstrate the ability to:

    a. Ball and burlap a tree or shrub.

    b. Transplant seedlings.

    c. Transplant a bare-root tree or shrub.

    d. Transplant container stock.

    (NOTE: If the above activities have not been finished before the test, ask your instructor when they should be completed.)

TRANSPLANTING
UNIT I

ANSWERS TO TEST

1. a. 6 c. 1 e. 4

   b. 5 d. 3 f. 2

2. a. Seedlings
   b. Rooted cuttings
   c. Bare-root
   d. Ball and burlap
   e. Container stock

3. c, d, f, h

4. a. 2 d. 3

   b. 6 e. 4

   c. 5 f. 1

5. a, b

6. a. Advantages

      1) Offers roots more protection than bare-root plants

      2) Can be done on extremely large trees, whereas bare-root can be done only on smaller plants

      3) Less time-consuming than bare-root in transplanting

   b. Disadvantages

      1) More time-consuming than bare-root in digging process

      2) Must use nails, twine, wire baskets, or some other material to contain soil ball

7. a. Time of year
   b. Soil moisture
   c. Temperature

8. a. Measure stem caliper 12 inches above soil line

   b. Multiply stem caliper by 10 inches and 12 inches for range of soil ball diameter

   c. Depth of ball is 1/2 to 2/3 diameter of soil ball

9. a, d, g

10. c, d, f

11. Performance skills evaluated to satisfaction of instructor

REPOTTING
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to repot plants. This knowledge will be evidenced by completion of the job sheet and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List signs that repotting is needed.
2. Select from a list correct statements about pot selection.
3. Arrange in order the repotting procedure.
4. Demonstrate the ability to repot a plant.

REPOTTING
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Provide student with objective sheet.

   B. Provide student with information sheet.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in the job sheet.

   F. Take a field trip to a greenhouse or nursery center to observe repotting on a larger scale.

   G. Have students bring plants from home in need of repotting.

   H. Give test.

   I. Reteach if necessary.

II. Instructional materials

   A. Objective sheet

   B. Information sheet

   C. Job Sheet #1--Repot a Plant

   D. Test

   E. Answers to test

III. Unit reference--*Living With Happy Plants.* The John Henry Company, P.O. Box 17099, Lansing, MI 48901.

REPOTTING
UNIT II

INFORMATION SHEET

I. Signs that repotting is needed

   A. Plant needs more frequent watering

   B. Roots are matted tightly together

   (NOTE: This is often referred to as "rootbound.")

   C. Plant growth slows down

   D. Plant is top-heavy

   E. Plant is oversized for the container

II. Pot selection

   A. Pot should have a drainage hole

   B. Pot should be no more than one or two inches larger in diameter than the current pot for houseplants

   (NOTE: Some plants, such as nursery stock, may be planted directly into a large pot.)

   C. Pot should be clean

   D. Pots used before should be scrubbed clean and disinfected with a bleach solution

   Example: 9 parts water to 1 part bleach

III. Repotting procedure

   A. Select pot slightly larger than current pot

   B. Place some soil in bottom of pot for proper placement of plant

   C. Remove plant from old pot by placing fingers over top of soil, turning pot upside down and tapping pot rim on solid surface

   D. If plant is rootbound, loosen rootball and remove dead or damaged roots

   E. Place plant in new pot

   F. Fill in around soil ball with potting soil

   (NOTE: Soil surface should be 1/2 to 3/4 inches below pot rim to prevent water overflow and allow enough water reservoir for watering.)

   G. Firm soil in around plant

   H. Water plant thoroughly

REPOTTING
UNIT II

JOB SHEET #1--REPOT A PLANT

I. Materials and equipment

   A. Plant needing repotting

   B. Pot 1 to 2 inches larger in diameter than current pot

   C. Potting soil

   D. Water can, pitcher, or hose

II. Procedure

   A. Partially fill pot with soil, leaving room for soil ball and an additional 1/2 to 3/4 inches of space at the top of the pot

   B. Remove plant from pot by placing fingers over the soil, turning pot upside down, and tapping edge of pot on a solid surface

   C. Place plant in new pot

   D. Fill area around plant with potting soil

   (NOTE: The old soil ball should be even with the new soil line.)

   E. Firm soil in, leaving 1/2 to 3/4 inches of space at top of pot to prevent overflow of water and provide a reservoir

   F. Water thoroughly

REPOTTING
UNIT II

TEST

NAME ______________________ SCORE __________

1. List signs that repotting is needed.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

2. Select from the following list correct statements about pot selection. Mark each correct answer with an "X."

_____a. Plants in drainless pots are easier to take care of because they don't lose any water out of the bottom of the pot

_____b. Pots used before should be scrubbed clean and disinfected with a bleach solution

_____c. Pot should always be much larger than the current pot to let the plant have plenty of time and room to grow

_____d. Pot should be clean

_____e. Pot should be no more than one or two inches larger in diameter than the current pot for houseplants

3. Arrange in order the repotting procedure. Mark the first step with a "1," the second step with a "2," and so on through step 8.

_____a. If plant is rootbound, loosen rootball and remove dead or damaged roots

_____b. Firm soil in around plant

_____c. Select pot slightly larger than current pot

_____d. Place some soil in bottom of pot for proper placement of plant

_____e. Water plant thoroughly

______f. Place plant in new pot

______g. Fill in around soil ball with potting soil

______h. Remove plant from old pot by placing fingers over top of soil, turning pot upside down and tapping pot rim on solid surface

4. Demonstrate the ability to repot a plant.

(NOTE: If this activity has not been finished before the test, ask your instructor when it should be completed.)

REPOTTING
UNIT II

ANSWERS TO TEST

1. a. Plant needs more frequent watering

   b. Roots are matted tightly together

   c. Plant growth slows down

   d. Plant is top-heavy

   e. Plant is oversized for the container

2. b, d, e

3. a. 4

   b. 7

   c. 1

   d. 2

   e. 8

   f. 5

   g. 6

   h. 3

4. Performance skills evaluated to satisfaction of instructor